Connection with Assam Trading Company's line at Dibrugarh.

Connection is established with the Assam Trading Company's line a short distance west of the Dibrugarh (Raiabaree) Station. The position of the junction station can be much improved by moving it a few chains farther east.

Estimate for total section.

The length of the traverse is 97·73 miles, and the total estimated cost of Rs. 73,83,338, or Rs. 75·549 per mile.

Estimate divided into two sections.

Divided into two sections, as treated above, the estimates stand as under:—

Sections.	Miles.	Rate per mile.	Amount.
		Rs.	Rs.
Golaghat to near Dikhu river . . .	57·0	63,570	36,23,516
Near Dikhu river to Dibrugarh . . .	40·73	92,311	37,59,882
TOTAL	97·73	75,549	73,83,338

Estimate from Kamarband Ali to Dibrugarh.

If the section between Golaghat and Kamarband Ali be struck out, the mileage and amount columns will be reduced by 6·23 miles and Rs. 3,49,541, and the totals will then be 91·5 miles and Rs. 70,33,797.

Mean height of bank.

In the first section the bank averages 6·3 feet in height and on the second 9 feet.

Dikhu bridge designed to take road traversed.

The bridge over the Dikhu is designed for a combined road and railway bridge on the same level, in order to facilitate communication between the Nazira Railway Station on the left bank of the river and the district and station of Sibsagar on the right bank.

Cheap line only to be obtained by keeping formation low and allowing floods to pass over.

If a cheap line is desired between Dikhu and Dibrugarh, it can only be obtained by allowing the flood-water to pass freely over the line, accepting the inevitable stoppage of traffic which must ensue; but this I cannot recommend, for such a line would fail precisely at the season when it was most wanted to carry tea.

Golaghat-Makum junction.

13. After seeing the country, I am persuaded that it would be a mistake to take the railway direct to Dibrugarh, which, as far as I know, only came to be spoken of as the terminus, because at present it is the place of greatest importance in Upper Assam.

General reasons for recommending this route.

A much easier line can be got by making for Makum junction on the Assam Trading Company's railway thirty-three miles east of Dibrugarh, and this line will both open up and serve the country better, and be more favourably placed for giving access to the Naga Hills and for tapping the coal-fields which lie along their base.

Alignment practically common to either route for first 50 miles.

General route thereafter of alternative.

For the first 50 miles from Golaghat the alignment would be practically the same for either line, but from this point the Makum junction line diverges and crosses the Dikhu river just above Nazira; it then makes for the Rajgurh Ali, which it follows to near the Disang river, crosses the Disang a little below the junction of the Saffrai, and keeps along the right bank until within seven miles of Jaipur; the Dehing is crossed just above the Jaipur bazar, and the line then runs straight, and almost due north, to Makum junction.

It was not possible to run a traverse over the whole of this alternative, but practically the only portion remaining unsurveyed is one of about twenty-five miles along the right bank of the Disang, which is so particularly easy that, after having gone over most of the ground personally, I can give an estimate which cannot be far from the mark. Plans and sections are submitted for the whole line, save these 25 miles between Nazira and Makum junction.

Alternative crossing of Jhanzi river.

In connection with the project a large plan is also submitted containing an alternative crossing of the Jhanzi river, and a survey of the adjacent tea-gardens: the line laid down on it may be adopted with advantage to several gardens, and might even be taken for the Dibrugarh line, though it will add slightly to the length of that.

Rajgurh Ali between the Dikhu and Disang rivers.

Between the Dikhu and the Disang I propose to make use of the Rajgurh Ali for about ten miles. This is an old Assamese embankment, averaging here about twelve feet high, and from 25 to 30 feet broad on the top. The Managers of the Nahorhabi and Lukwa gardens, who have within the last few years reclaimed from the jungle the portion which lies between the Dhodar Ali and the Disang, are perfectly agreeable that it should be taken up for the railway, and, as they are the only interested parties, no objection can be raised in other quarters to my proposal. It is the finest piece of embankment which I have seen in Assam, raised high above floods, thoroughly well consolidated, and laid out in good straight reaches, so that it is very well adapted for the railway. I propose to give a cart-road alongside, but beyond the foot of the slope on the east side, and the cost of this has been included in the estimate.

Reasons for adoption of route along the right bank of the Disang.

The Dhodar Ali, north of Nazira, keeps between the Disang and Nága Hills until it is within seven miles of Jaipur. The reason for crossing to the right bank of the Disang will at once be apparent from the map: it will be seen that the river, for nearly 30 miles of the proposed railway, intercepts the drainage from the hills, and for this distance it would appear possible to make an alignment, in which not a single opening would be required. This would, of course, involve a certain amount of curving which would remain as a permanent blemish on the line, while it is doubtful if it would effect any economy, even in the first instance. I have, therefore, assumed in the estimate for a line running fairly straight, 24 lineal feet of waterway per mile, and allowed for a bank of an uniform height of five feet.

The section between miles 22 and 24 from Makum junction shows the nature of the work.

The Mamoora Ali.

The Mamoora Ali, near which the line will run, is covered with jungle, with the exception of where there is a narrow foot track along the centre, and, as far as I have seen, the embankment varied from a few inches to about four feet high. In answer to all enquiries, I was assured that the Disang has never been known to flood over the road, and there were no traces of its having done so. In this upper part of its course the banks, wherever I saw them, and more especially the right one, are very high, and I, therefore, believe the information to be correct. The alignment should keep fairly close to the right bank, where the ground is highest, and whence it slopes towards the Diroi, which carries off the surface drainage.

The Rajgarh Ali, north of the *Disang*.

North of the Disang I believe the Rajgarh Ali is not nearly so fine an embankment as the portion on the south side. I have only seen five miles of it, which have been cleared between the Tinkhan and Joriapokhar gardens; the rest, I was assured, lay buried in jungle, such as I saw the clearance end in. This portion of the road is narrow, traverses ground cut up by a multitude of small watercourses draining into the Diroi, and had evidently been breached in several places; the Mamoora Ali, on the other hand, traverses a perfectly flat country, with scarcely a sign of a watercourse of any kind.

Objections to taking line between the Nága Hills and the Disang.

Were the line taken along the left bank of the Disang, it would have to cross a large number of streams, many of considerable size; but such an alignment, while being very costly, would not also, in my opinion, serve the country so well, inasmuch as it would be too much to one side of the valley, from the greater portion of which it would be isolated for some 30 miles by the Disang river.

Dhodar Ali, neither suited nor available for the railway.

The Chief Commissioner, Mr. Elliott, has recorded his objection to the Dhodar Ali being taken up for the railway. Entirely concurring in his objection, it may be well to add that, so far as I saw the Dhodar Ali north of the Dikhu, it is quite unsuited for the railway, and that it is a mistake to suppose that any economy would be effected by making use of it, were it desired to carry the line east of the Disang. I do not propose to utilise the Mamoora Ali, as it winds about too much, though, as at present it lies buried in jungle, no objection would probably be raised to doing so.

Disang to Jaipur.

Between the Disang and Jaipur some drainage from the Nága Hills is encountered, but nothing of any great consequence.

Dehing river.

Ten spans of 100 feet have been provided for the Dehing, equal to the full width of channel.

About one mile above Jaipur, the river issues from a gorge in the Tippam range, and the crossing selected is between this and the bázár, where the banks are stable and the river cannot alter its course. The highest flood is said never to have quite topped the left bank, on which Jaipur is situated, but the levels would show that the right bank has been topped by a few inches; but this can easily be prevented by making a small bund along the bank of the river between the railway embankment and the hills.

A narrower crossing might be got close up to the gorge, but the water here is deep, and it would be very difficult to found the piers, while they would have to be made very secure to resist the violent action of the water. I understand, too, that the river is sometimes covered with masses of floating timber, so that I prefer to place the bridge some distance below the gorge, where the river is wider and the velocity of the current is much reduced.

Jaipur to Makum junction.

Between Jaipur and Makum junction the line passes entirely through forest, and there is nothing calling for special mention.

Comparison of distances.

The distance between Golághát and Dibrugarh by this route will be about 156 miles, against 98 by the direct route; but, on the other hand, it slightly reduces the through distance to all points above Makum junction.

Estimate for the alternative.

The estimates for the total alternative may be taken as under :—

Sections.	Mile.	Rate per mile.	Amount.
		Rs.	Rs.
Golaghat to Nazira	56·5	63,225	35,72,222
Nazira to Makum junction	66·43	69,495	46,16,521
TOTAL .	122·98	66,613	81,88,743

Thus, this alternative project gives about 25 miles more of railway to construct, but at an increased cost of only Rs. 8,05,405.

Alternative easier to maintain.

It will also be an easier line to maintain, for it is on higher ground, and not liable to be breached by the Dehing; while a minor point in its favour is the existence of natural stone ballast in the upper courses of the Disang and Dehing close to the line.

Opinions regarding the route proposed.

The Deputy Commissioner of Lakhimpur and many tea-planters have expressed their concurrence in my views regarding the superior merits of this route; in fact, I did not meet any one who had anything to urge in favour of the other. One gentleman wrote, urging upon me the claims of the Dhodar Ali as a route between Nazira and Jaipur, using as an argument that the road might be utilised for the railway, but the objections to this need not be reiterated.

Concluding remarks on work above Golághát.

Before quitting the subject, I have only two or three more remarks to make.

Possible insufficiency of waterways allowed for Dehing flood to be provided against.

I think that the waterways allowed to pass the Dehing flood on the Dibrugarh line err, if anything, on the side of being under the mark, and some of the bridges should be built with pier abutments, so that they may be readily extended if necessary.

General designs for large bridges.

The larger bridges of 100-feet span are designed to have the girders supported on brick piers, resting, with one or two slight exceptions, on wells, which, in the absence of borings, are assumed to be carried to a depth of 50 feet below lowest point in bed of stream.

Curves not laid out and traverses worked in sections.

No attempt has been made to lay out any curves, and, on account of the great extent of forest, the traverse was done in sections, the connections between which are sometimes rather acute: the traverses, therefore, are very slightly longer than the final alignments will be. Only 39 miles out of the 98 between Golághát and Dibrugarh are said to be in cultivation, the remainder being waste or forest.

Opinion on the project.

14. My visit to Upper Assam gave me the first opportunity I have had of discussing with any considerable number of tea-planters the question of railway communication with those parts.

As the result of investigation and discussion, the various projects which have been proposed are now practically reduced to two; one offering a connected scheme by which the Brahmaputra valley would be linked, through the North Cachar Hills, with a line from Chittagong to Cachar; the other two totally independent and disconnected lines, confined to the Brahmaputra valley on the one side and Chittagong-Cachar on the other; the former is the scheme which the last two years have been spent in elaborating.

Whichever of these two projects were adopted, the alignment above Golághát would be practically identical, and the men whose gardens lie along this portion of the route should, therefore, be impartial judges, while any consensus of opinion from them must be valuable, as it is from this section that the railway will draw by far the greatest bulk of any traffic which the gardens can give.

Where I have had an opportunity of explaining the subject, the result has been, I think, entire concurrence with my views, and general assent to the expression made by Mr. Phillips of Nazira, that the second project, giving them simply a line to Dhubri, would place them in little better position than they are in now. I have endeavoured to put the position clearly before them, so far as it affected them.

It was agreed at once that those gardens which send their tea direct to London would ship through Chittagong, but a belief was also not infrequently expressed that trade would gradually be diverted to that port; and one of the most influential planters saw no hindrance to the bulk of the tea being shipped through Chittagong, but still sold, without dislocating present arrangements, from samples in Calcutta. But, apart from all this, it was unhesitatingly granted, that if both routes existed, one *viâ* Chandpur and the other *viâ* Dhubri, offering a choice of communication with Calcutta, the former would be selected. The question was discussed simply on the basis of difference of mileage with equality of mileage rates, one line against the other, not the railway *versus* the river, which is a different question. Whether the railway can compete with the river steamers for the trade with Calcutta (the steamers having no chance with Chittagong) depends greatly upon the rate at which it can afford to carry the tea: if it can afford to carry at such a rate that the total charges do not exceed those by the river, the great saving in time and some minor considerations, such as the trouble and vexation of long carriage to the Brahmaputra, will turn the scale in its favour. That the railway can do this there can be little doubt.

The great majority of the gardens in the Sibsagar District, and a considerable number of those in South Lakhimpur, lie close to it. These probably on an average do not at present pay less than one rupee per maund to get their tea to the river, whereas four annas should suffice to carry it to the railway, and the balance will convey it well on towards Chandpur: taking Nazira as a centre and a rate of one-third pie per maund per mile for the railway carriage, 12 annas would in fact just land it there, so that it is evident a higher rate could, if necessary, be charged.

In the reports on the work of the season 1882-83, I ventured to make an estimate of the probable amount of traffic the railway may expect, and as I can offer nothing better, I shall not cumber this report by going over the ground afresh. The existence of good water-communications, and in parts the absence of reliable data render any estimate little better than pure conjecture. I took what I considered a moderate estimate, and showed from these figures that the scheme, as a whole, should pay 5 per cent. on the capital outlay after deducting 50 per cent. for working expenses.

Manner in which the lines are shown on the index map.

15. On the index map the line which is recommended for adoption following the traverses described is shown by a full red line. The dotted red lines indicate improvements which can be made in the final alignment, the blue lines represent alternatives which have been surveyed, and the black lines the portions which have been examined, but not yet surveyed, and which consist of about fifty-eight miles in the North Cachar Hills, fifty-two miles between Gauháti and Roha, and twenty-five miles on the right bank of the Disang.

Proposed work during cold weather of 1885-86.

While writing this report I have received intimation that the Government of India desire that the surveys may be entirely completed during the coming cold weather. If the staff be maintained at its present strength, I have no doubt this can be accomplished. It will be necessary to put three parties into the North Cachar Hills, and this has already been approved of. A fourth weak party will be available for the Gauháti-Roha Section, and as it will not have enough to employ it during the whole of the season, I propose also to give it the short length along the right bank of the Disang to do. This is a very easy section, and I should not have thought of doing it if the survey of the Gauháti-Roha Section had not been required. The detailed survey will, however, be somewhat useful, as it will fill up an existing gap and enable complete plans for the project being submitted.

Concluding remarks.

16. In conclusion, I have to express my thorough appreciation of the manner in which the various members of the staff have worked, and I trust the results will be considered satisfactory. Mr. Soppitt, as usual, gave the greatest assistance in the North Cachar Hills in the way of furnishing coolies and supplies, and the Deputy Commissioners of the Nága Hills and of Nowgong rendered valuable aid to the work in the Dimapur valley.

Enclosure No. 4 to P. W. D. Resolution No. 868 R. C. of 1887.

Note by W. E. Ward, Esq., C.S., Officiating Chief Commissioner of Assam,—dated 19th September 1885.

This report may be at once sent on to the Government of India, who, I hope, will sanction the completion of the survey this next cold season.

2. I agree with all Mr. Buyers' proposals as to the alignment from Badarpur to Dibrugarh, though I should prefer to see the line pass through Silchar. I hope shortly to see an accelerated daily steamer service established between Naraingunj and Silchar. Obstacles in the river which cannot be removed except at great expense prevent the steamers from going right up to Silchar in the dry season, and it will probably be necessary to make Karimganj the terminus for five months in the year. In order, therefore, to connect Silchar with Calcutta a tramway from Karimganj to Silchar will probably be required if these two stations are not connected by the railway.

3. In paragraph 14 the Engineer-in-Chief discusses the relative merits of two schemes, *viz.*, (1) that of two disconnected lines, one in the Assam Valley, and the other in the Surma Valley, and (2) that of connecting these two lines by a section through the North Cachar Hills. Upon this question I have read with interest Mr. Buyers' report of the survey operations of the year 1883-84 (No. 1527, dated the 31st July 1884), but neither here nor elsewhere have I found any reply to my arguments against what I may call the North Cachar connection scheme as contained in my note of the 29th August 1883, which was forwarded to the Government of India with Mr. Buyers' report on the survey operations of 1882-83. Those arguments simply amounted to this :—There can be no reasonable doubt that the Surma Valley or Cachar-Comilla-Chandpur line would pay a fair rate of interest to Government or to any Company who chose to take it up. On the other hand, an Assam Valley line from Dibrugarh to Gauhati or Dhubri would probably not for some years yield a sufficiently remunerative interest on its capital expenditure, in whatever direction that line be taken, whether along the Trunk Road, or *viâ* Lumding. These being the facts, I think it would be most unwise to hamper these two lines by an unprofitable and expensive connection between Lumding and Badarpur, a distance of about 114 miles, passing through a barren country and no population. I am fully convinced that this connection will bring no additional traffic to the Assam Valley, that a disconnected Assam Valley line from Dibrugarh to Gauhati and Dhubri would not also bring. It will, of course, bring additional traffic and also cheap coal to the Cachar-Comilla line, particularly if the connection between Lumding and Gauhati or Dhubri is postponed, as it probably will be, for some years; but the view which I take is that the Cachar-Comilla line does not want this additional traffic, as it can stand upon its own legs without being connected with the Assam Valley. In that case, if the Government of India ever contemplated a State Railway scheme in this Province, I could not advise it to expend Rs. 1,34,00,000 on the North Cachar Hill section; but I would certainly advise it to save this money, and spend it on the completion of a disconnected Assam Valley line from Dibrugarh to Fakirganj (opposite Dhubri). If this recommendation be adopted, the Assam Valley may hope to see before many years, what it stands so much in need of, a line of railway running through its whole length; otherwise, I fear much that the requirements of the Assam Valley will be sacrificed with no compensating gain to any other portion of the Province. I am aware that the whole scheme which has been brought under Mr. Buyers' survey contemplates a connection between Lumding and Gauhati; but, if the railway be taken through the North Cachar Hills, I think it is not difficult to foresee that this connection will be indefinitely postponed, and the Assam Valley will suffer in consequence.

4. In paragraph 73 of his report of 1883-84, Mr. Buyers quoted the opinion of Mr. Phillips, of Nazira, upon the relative merits of the two schemes referred to, and in paragraph 14 of his present report he states he has consulted several other planters on the same question; and the conclusion he has come to is that the planters of Upper Assam are unanimously in favour of the North Cachar connection and agree with the opinions expressed in Mr. Phillips' letter that an unconnected line from Dibrugarh to Dhubri would put them "in little better position than they are now." I think I should warn the Government of India against accepting this as the planters' view of the question, without knowing more clearly than Mr. Buyers' report tells us upon what considerations it is based. The matter has been discussed by me with many planters; and it is quite certain that it is perfectly immaterial to them whether they ship their tea for Calcutta at Fakirganj or at Chandpur. All the planter cares about is the cheapest and most expeditious means of conveyance. As regards expedition, there is certainly something to be said in favour of the line to Chandpur, as there would be a saving in time of, perhaps, some 4 or 5 days; but I doubt if this saving is of very great importance to the planter. As to the comparative cost of freight to Calcutta under either scheme, Mr. Buyers' report gives no information. This can only be determined when it is settled at what mileage rate the Railway will carry tea either to Fakirganj or Chandpur, as the case may be, and at what rate the Steamer Companies will carry to Calcutta from Chandpur or Fakirganj.

5. The question of mileage rates was discussed in paragraphs 10 and 11 of my Note of the 29th August 1883. I there pointed out that, if tea were carried along an Assam Valley line to Fakirganj at the rate of ¼th pie per maund, it would cost 8 annas a maund to land Dibrugarh tea at Fakirganj; if the freight was fixed at ⅜th pie per maund the cost for the whole distance would be 12 annas a maund. Mr. Buyers in his present report calculates that the large majority of tea-gardens in Sibságar, and a considerable number of those in the south of the Lakhimpur district, pay now on the average not less than Re. 1 a maund for carriage of their tea from the gardens to the Brahmaputra river, whereas he thinks 4 annas would suffice to carry it to the Railway, thus effecting a saving of 12 annas a maund, which, Mr. Buyers very truly says, will carry the tea "well on to Chandpur; but if this estimate be accepted, it applies equally to an unconnected Assam Valley line; that is to say, the saving noticed will carry Upper Assam tea as far as Dhubri, and even farther than that if the freight is reduced to ¼th pie, or, as Mr. Buyers suggests, to ⅓rd pie per maund per mile. It only, therefore, remains to ascertain and compare the rate at which the steamers will carry from Fakirganj and from Chandpur; and as in this matter both the Government and the planter are in complete ignorance of what the Steamer Companies will or can do, it is quite impossible that the planters of Upper Assam can give any opinion worth having upon the relative merits of the two schemes under discussion. It must be borne in

mind that no presumption can be drawn from the fact of Chandpur being nearer Calcutta than Fakirganj, that steamer freights from the former place will necessarily be cheaper. We know from experience that the River Companies do not regulate their freights according to the distance travelled. The case then stands thus, if we assume, as I think we fairly may do, that the Companies will carry tea from Fakirganj or Chandpur at Re. 1 a maund:—The mean distance from Upper Assam to Fakirganj along the Trunk Road is 347 miles (*see* paragraph 14 of my Note of 1883). If the Assam Valley line be taken *viâ* Lumding, the distance is, according to paragraph 72 of Mr. Buyers' report of last year, 30 miles longer, *i.e.*, 377 miles. Tea carried over this distance at $\frac{1}{3}$rd pie per maund per mile will cost 10 annas a maund to land at Fakirganj; if carried to Chandpur, a distance of 474 miles, the cost to land it there will be 13 annas a maund. Thus, the freight (railway and steamer) from Upper Assam to Calcutta will be *viâ* Fakirganj Re. 1-10, and *viâ* Chandpur Re. 1-13 a maund. It is difficult to see how, with these figures before them, the planter of Upper Assam could prefer the Chandpur route. Still more difficult is it to understand Mr. Phillips' statement that the planter will gain little by carrying his tea to Fakirganj by rail and shipping it there. The Assam Company, of which Mr. Phillips is Superintendent, has its tea carried to Calcutta by the India General Steam Navigation Company at a contract rate of Re. 1-8 a maund, and it is probable that Mr. Phillips compared only this rate with that of Re. 1-10 a maund mentioned above, or Re. 1-8 a maund if the mileage rate on the Assam Valley line be reduced to $\frac{1}{4}$th pie per maund per mile. But the saving of 12 annas a maund in land carriage, alluded to by Mr. Buyers as resulting from the establishment of the railway, whether connected or unconnected with Cachar, has been entirely overlooked by Mr. Phillips. At present, the gardens pay Rs. 2-8 a maund for carriage of their tea to Calcutta, including land carriage, and those gardens which have no contract with the Companies pay Rs. 3. With a railway to Fakirganj the freight to Calcutta, including land carriage, will be—

	Rs.	As.
Land carriage	0	4
Railway freight to Fakirganj	0	10
Steamer freight to Calcutta	1	0
Total	1	14

as compared with Rs. 2-8 or Rs. 3.

6. But, irrespective altogether of these figures, which go, I think, very clearly to show that, so far as the planter of Upper Assam is concerned, a disconnected Assam Valley line is preferable to one connected with the Surma Valley, I deprecate most strongly the merits of the question being determined from the planter's point of view only. Even if we accept the planter's view that he would gain nothing by a disconnected Assam Valley line, it is perfectly clear that he would lose nothing by it; and as the enormous gain which would accrue from such a line to the Assam Valley generally, irrespective of any consideration of the planting interest, cannot be disputed, I feel bound to urge all I can in support of it. I hold very strongly that the Assam Valley will never emerge from its present state of wilderness and isolation until a railway runs through it from one end to the other. The present fast line of steamers have no doubt done much to improve communication with Bengal, but they will not do in fifty years what a railway connected with Bengal *viâ* Dhubri will do in five.

7. I notice that Mr. Buyers is confident that a railway through North Cachar to Chandpur can compete with the steamers. I am not so sanguine on this point. It is well known that the steamers can reduce present freights very considerably. But, however this may be, if a line through the North Cachar Hills can compete, *a fortiori* can a disconnected Assam Valley line do so (upon this point see paragraph 11 of my Note of 1883).

8. These remarks make no reference to the prospect of Assam tea being at some future day for the most part exported direct to England *viâ* Chittagong. As I said two years ago this is a prospect too remote to affect the question under discussion. A few gardens may wish to export that way when the way is open, but I doubt much if the majority of gardens would do so.

Enclosure No. 5 to P. W. D. Resolution No. 868 R. C. of 1887.

No. 3176, dated 28th September 1886.

From—F. J. JOHNSTONE, Esq., M.I.C.E., Secretary to the Chief Commissioner of Assam, P. W. Dept.,
To—The Secretary to the Government of India, P. W. Dept.

BENGAL-ASSAM RAILWAY.

Survey Operations for 1885-86.

I am directed to forward, for the information and orders of the Government of India, two reports* with estimates by the Engineer-in-Chief, Bengal-Assam State Railway, the one dealing solely with last season's survey operations and the other a final report in which the whole work done by Mr. Buyers' survey party is reviewed.

* The two reports accompany this letter; the bundle of estimates has been forwarded by parcel post.

F. J. J.

2. The Chief Commissioner has no remarks to offer on the first report. In his second report Mr. Buyers enters again upon the discussion of the relative merits of a disconnected Assam Valley line and a connected line through the Cachar Hills with special reference to Mr. Ward's note of September 1885, submitted to the Government of India with Mr. Buyers' report of last year.

3. The Government of India will not expect the Chief Commissioner to prolong this discussion further. They are in possession of Mr. Ward's views and arguments and of the Engineer-in-Chief's reply to them and nothing more is required to enable the Government to judge of the comparative merits of the two schemes from a commercial as well as a financial point of view; Mr. Ward adheres to the views he has already expressed.

4. Setting apart as was done in Mr. Ward's note of September last, the question of tea being possibly exported at some future day *viâ* Chittagong, Mr. Ward must again repeat what he said in paragraph 4 of that note. It is quite immaterial to the planter whether he ships his tea for Calcutta at Fakirganj or Chandpur; all that he cares about is the cheapest and most expeditious means of transit to Calcutta, and, where difference in time is not great; what he mainly looks to, is the cheapest route. Mr. Buyers says he has not found a planter opposed to the connected line which he advocates, when the facts have been properly placed before him. Mr. Buyers has, of course, told the planter that his line is the cheapest route to Calcutta for their tea, irrespective of the possible advantages which hereafter may accrue to him when Chittagong is made fit to receive tea for export. It goes, therefore, without saying that the planter of Upper Assam is all in favour of the North Cachar route. It is a question, however, for the Government of India to decide whether that route will, when the line is made, be a cheaper route for tea than one down the Assam Valley to Fakirganj, and also whether it will be able to compete with the steamers. If the Government of India entertains any doubt on these points, then the Chief Commissioner's advice is that money should not be wasted on what he considers is a very risky speculation.

5. If the question of Chittagong as a possible future port of export for tea is brought into the discussion, then the Chief Commissioner would urge that no decision whatever be come to by the Government of India upon the two alternative schemes under discussion until we know something more about Chittagong and its capabilities than, so far as the Chief Commissioner is aware, we know at present. Twenty years hence Chittagong may have developed into something considerably more than it is at present. If this is found to be the case, it will be sufficient time then to think of constructing a line through the North Cachar Hills; in Mr. Ward's opinion it is premature to think of such a line now. There is nothing, however, to prevent our commencing, or to our offering inducement to private Companies to commence, on the Chandpur-Comilla-Cachar line. A commencement might also be made at the other end from Makum to Lumding. When these two lines have been completed, we shall probably know more about Chittagong as the probable future port of export for Eastern Bengal and of Upper Assam than we do at present.

6. As the Government of India are in a hurry for the enclosed reports they are sent up in manuscript to save time, and it is asked that after they have been printed in Simla that 24 copies may be sent to this office.

Enclosure No. 6 to P. W. D. Resolution No. 868 R. C. of 1887.

BENGAL-ASSAM STATE RAILWAY.

Report by J. W. Buyers, Esq., M.I.C.E., Engineer-in-Chief, on the Survey operations during the season 1885-86.

Introductory.

To ensure the completion of the survey during the season it was necessary to make provision for placing three parties in the North Cachar Hills. We are greatly indebted to the Deputy Commissioner of Cachar, and to the local Sub-Divisional officer, Mr. Soppitt, for the assistance which they rendered, and which made this possible; the latter furnished a larger number of coolies than on any previous occasion, and his efforts were supplemented by the Executive Engineers themselves recruiting about 100 men in the Khasi hills, who did not however prove very valuable for the purpose for which they were engaged, *viz.*, jungle-cutting, and they were therefore chiefly employed in bringing in supplies from the Gunjong Depôt; the Deputy Commissioner purchased in the plains the necessary supplies and had them carried up to Gunjong; this alone employed a considerable number of men. During the last two seasons there has been no difficulty in procuring survey khallassies, of whom about 150 men have been yearly required. Many men of good stamp (a considerable proportion Goorkhas) have presented themselves for employment at the commencement of the season, and thus difficulties which we had in this respect at the outset have year by year diminished.

No. 1 Division.

Jatinga Valley.

Work done on this section during previous season 1884-85.

2. Mr. Sherman took up the work where he had left it the previous cold season; he had then carried two lines into the Jantinga Valley, starting from two different points on the Chittagong-Silchar line, and crossing the Barak river respectively at Badarpur and at Telyn-Tila: the former entered the Jatinga Valley on the right side, while the latter entered it on the left, but near its termination, crossed the Jatinga river and connected with the former at about 19½ miles from Badarpur. The Badarpur line is the one which I have recommended. In addition to the above, a length of six miles had been surveyed at the extreme head of the Jatinga working from the saddle downwards.

Work during season 1885-86.

3. Mr. Sherman's work during the past cold season then chiefly consisted in connecting the common point of the Badarpur and Telyn-Tila lines with the work at the head of the valley, but in addition to this he had one Engineer employed in taking borings in the Barak river at Badarpur, a work which it had not been possible satisfactorily to accomplish during the previous season.

Difficulties in way of taking borings in the Barák at Badarpur.

4. Treating of the latter first: the borings of the Barák proved a work of very considerable difficulty owing to the trouble and delay experienced in procuring suitable boats, the depth of water, and, after the end of February, to the rapid fluctuations in the level of the stream, and to the violent storms which sweep the valley and severely testing the tackling. The intention had been to carry the line across the Barák at the Badarpur fort where a small rocky spur projects into the river. It had been previously noticed that the river had scoured out a deep and broad hole immediately in front of the spur, the bottom of which was about 10 feet below mean sea level at Chittagong, while the mean low water level of the river was about 27 feet above sea level.

Proposed crossing moved below Badarpur fort.

5. The borings taken this season proved that it would be necessary to carry the foundations deeper even than had been estimated for; the greatest depth to which they have gone is 92 feet below the general bed of the river, or say 76 feet below mean sea level; fine sand and silt were met with, without intermission, the whole way, and from near the bottom a few pieces of brick were brought up which had probably fallen into the river from the fort. The results were altogether so unsatisfactory, that it was determined to try fresh borings about 700 feet lower down stream, at a point where the course of the river cannot materially change, as it is directed by small hills. Here stiff clay, intermixed with a little sand, was almost invariably found in the three borings, which were taken to a depth of 80 feet, but in one the auger struck, at a very considerable depth, upon what appears to be a snag. In consequence of the more favourable results obtained from these borings it is proposed to cross the river here, and a small piece of line has been laid down to connect this crossing with the lines on either side already surveyed, as shown on the plan.

Design for Barák Bridge.

6. The design for the bridge has been altered to suit the new conditions: instead of three spans of 250 feet as proposed for the fort crossing the design is now for a bridge having two centre spans of 250 feet and two side spans of 200 feet: the estimate for the new bridge amounts to Rs. 85,953 more than that for the old, but no comparison can fairly be instituted between the two, as the latter was based on an assumed depth and nature of foundations on which it is now proved that we cannot calculate. The design for the piers of this bridge consists of a couple of 23 feet brick wells sunk about 76 feet into the bed of the river with a steel trestle 50 feet high on top, the latter being composed of four raking columns three feet diameter filled with concrete, and braced together in the usual way. In a country subject to frequent shocks of earthquake, it was thought advisable to adopt a design and material which, combined, possess the greatest elasticity.

Revised estimate submitted.

7. On account chiefly of these alterations, a revised estimate is submitted for the 19½ miles of line from Badarpur into the Jatinga in lieu of the estimate of last year.

Section above junction of Badarpur and Telyn-Tila lines.

8. The distance from this, the common point or junction of the Badarpur and Telyn-Tila lines, to the point six miles below the saddle is 19·25 miles. Work was commenced from the upper point. In my report on the exploration of the North Cachar Hills it was noticed that the Kayeng Valley would afford the means by which a grade of 1 in 70 or even an easier grade, might be secured. But as it was believed that 1 in 70 would be the limiting grade on other sections in these hills, the traverse was run to secure this, as there was little to be gained by an easier gradient, which would have entailed a corresponding lengthening of the line. From the traverse, and the cross sections, a line has been laid down on the plan which practically gives a gradient of 1 in 70 for nearly

22 miles from the saddle down, but broken by short lengths of level and one short length of an easy gradient, including provision for three stations, the length of such breaks aggregating 57 chains. Thence down to the common point is 3¼ miles, in which varying gradients, none exceeding 1 in 70 and these only few and for comparatively short lengths, have been employed to suit the configuration of the ground.

Consideration determining alignment.

9. The alignment over these 3¼ miles was tied by the latter consideration : on the one side there is the Jatinga river and on the other steep hill sides, further up which the line could only be thrown at great increase of cost, owing to the numerous ravines. Where time did not permit of elaboration, it was the simplest plan to lay down the uniform gradient of 1 in 70. No doubt the alignment can be somewhat improved upon even with this gradient, though, in laying down the line finally, it would be well to somewhat ease this grade on the curves at the expense of stiffening it on the straights. The minimum curve employed is one of 573′ radius (five degrees deflection per chain), and a short length of straight, at least 100 feet has always been interpolated between reverse curves of whatever radius.

Estimates.

10. This section of 19·25 miles is estimated to cost Rs. 52,61,491 or a mean rate of Rs. 2,73,324 per mile, and this may be accepted as a fair estimate of what any line, following approximately the alignment laid down with the above limiting curves, would cost, though with further elaboration, some, but no very material reduction, could doubtless be made ; if such be sought for on this alignment it can only be obtained by adopting sharper curves, and there can be no doubt that these would better suit the topography of the ground. It is to be regretted that there has not been time to lay down and estimate for a continuous line with curves of a minimum radius of about 400 feet, but a calculation has been made of the effects of using curves of 400 feet radius at certain points which are indicated on the plans and sections, and this shows that the estimate of the 19·25 miles may be reduced by Rs. 6,96,117 and of the 6 miles at the head by Rs. 1,24,037.

Causes of high rate.

11. This high estimate is due to the broken and rugged nature of the ground, consisting of deep ravines separated by sharp spurs. From the point where the line enters the hills up to the saddle at the Jatinga head, there are 13 tunnels aggregating 5,281 lineal feet. Viaducts, spanning ravines are both numerous and heavy : by far the most formidable being over the Lokamah and Lokasah, the former being estimated to cost Rs. 3,73,020 and the latter Rs. 3,34,637 ; another very heavy viaduct is that over the Dittok Cherra, the estimate for which amounts to Rs. 2,65,762 : there are 6 other viaducts, each of which is estimated to cost over one lakh of rupees. The longest span adopted is 150 feet, and the greatest height of formation above bottom of ravine is 236 feet, the maximum height of centre piers in this case being 216 feet. All the heavy viaducts lie above the Kayeng, that is they are concentrated in the upper length of 19 miles, where the line runs up the hill side : they are with scarcely an exception on sharp curves, and this has been one reason for limiting the spans, but in the larger spans employed allowance has been made for increased width and consequently weight of girders to take the curvature. All the large spans are carried on steel or iron trestles which rest on masonry pedestals.

Minor bridging.

12. The rate for minor bridging amounts to Rs. 21,208 per mile, which high rate is due to the great number and size of culverts required to pass the large amount of drainage, due to the heavy rainfall which frequently exceeds 200 inches per annum ; the co-efficient for these has been fixed with reference to a fall of six inches in an hour, and adopting Colonel Dickens' formula comes to 1,856.

Comparison with preliminary estimate.

13. In my report on the exploration of the North Cachar Hills, I assumed that the hill section commenced at a point 11 miles from Badarpur, and I estimated that the cost of the line from this point to the Jatinga saddle would amount to Rs. 1,80,000 per mile, practically on the alignment which has been adopted. The distance from Badarpur to the saddle is 44·819 miles, from which, deducting 11 miles, leaves 33·819 miles for this portion of the hill section : at my rate the estimate for this would amount to Rs. 60,87,420, whereas employing minimum curves of 573 feet radius, it works out to Rs. 74,13,868, or roughly 13¼ lakhs above my estimate; but in the above report I stated that my estimate was based on work done in the Garo Hills, wherein curves of 400 feet radius had been employed, and, to institute a fair comparison, the lower estimate, which shows a reduction of Rs. 8,20,154, at least, from using 400 feet curves should be taken.

Level of formation at certain points.

14. The following figures referring to levels may be interesting : at Badarpur station, mile 254 from Chittagong, reduced level of formation is 66 feet ; near mile 267, where the line may be said truly to enter the hills, the reduced level of formation is 110 feet ; at mile 276½, where the continuous ascent of 1 in 70 begins, it is 285 feet ; and at the Jatinga saddle near mile 298½ it is 1,863 feet, formation here being in cutting 80 feet below the top of the saddle.

Statement of length and cost from 11 miles from Badarpur to Jatinga saddle.

15. From what has been said, and from the sections, it will be seen that the bulk of the heavy work lies above the Kayeng, and the following figures further bring this out :—

Section.	Miles.	Estimated cost.	Rate per mile.	REMARKS.
		Rs.	Rs.	
Miles from Badarpur 11 to 24·38 .	13·38	16,61,506	1,24,178	Mile 24·38 is just below the mouth of the Kayeng and is equivalent to mile 278 from Chittagong.
„ „ 24·38 to 44·82 .	20·44	57,52,362	2,81,427	
Total .	33·82	74,13,868	2,19,215	

That is when the line is carried along the base of the hills, as it is between miles 11 and 24·38, the cost per mile is only slightly over Rs. 1,24,000 per mile, whereas, after it begins fairly to ascend the hill side, the mileage cost amounts up to over Rs. 2,81,000.

Alternative line from the Kayeng river upwards.

16. It then becomes of importance to consider what will be the effect of continuing the line by easy gradients along the bottom of the valley as far as a point from which it will be possible to ascend with a sharp gradient, say not less than 1 in 40. The great point, if possible, is to avoid the heavy viaducts over the Lokamah and Lokashah, and the adjacent long tunnels. Mr. Sherman was able to run an alternative of 6½ miles, starting from mile 24·38, and terminating about a mile above the Lokashah (the upper of the two ravines, and not the lower, as shown in the topographical maps.) This line starts off with reduced level of formation 400 and terminates with reduced level 516 : it thus rises 116 feet in 6½ miles, which enables generally easy gradients to be employed, although the grade of 1 in 70 is necessary at a few points to surmount spurs. The line keeps close to the Jatinga, avoids all heavy viaducts and tunnelling, and is estimated to cost Rs. 7,94,587, a mean rate of Rs. 1,22,621 per mile, or very nearly the same rate per mile that the lower section is estimated to cost. Between the termination of this alternative and formation of the upper line at the saddle, a height of 1,347 feet has to be overcome ; the distance from the opposite point on the upper line to the saddle is 10·34 miles, so that, assuming that the distance would be the same, the ascent can be accomplished with a uniform grade of 1 in 40, leaving a margin of about 7 chains, but judging from the contour of the hills, it is believed that the line would be somewhat longer ; it certainly cannot be less. From comparison with the corresponding section of the upper line, and making allowance for the fact that on the first two or three miles the line would not be far up the hill-side, an estimate has been framed, which it is believed may be accepted as tolerably accurate, but if any thing it probably errs on the side of excess ; this amounts for the 10·34 miles to Rs. 20,82,891, a mean rate of Rs. 2,01,440 per mile. The results of this alternative may then be tabulated :—

Section.	Miles.	Estimated cost.	Rate per mile.	REMARKS.
		Rs.	Rs.	
Miles from Badarpur 11 to 24·38 .	13·38	16,61,506	1,24,178	
„ „ 24·38 to 41·20 .	16·82	28,77,478	1,71,075	6·48 + 10·34 miles.
Total .	30·20	45,38,984	1,50,297	
Difference in favour of lower alternative	3·62	28,74,884	...	

or comparing the two lines between their common points, mile 24·48 and the Jatinga saddle, the alternative effects a saving of nearly 50 per cent. in cost.

Grounds for recommending this alternative.

17. I recommend that this alternative be adopted, the following being some of the chief reasons :—

(1) Great economy in first cost.

(2) Economy of time in constructing, any reduction of work being a matter of special importance in a country where labour is difficult to procure and the working season is short.

(3) Maintenance will cost less and be easier, on account of the position of the line, the reduction in length, and the avoidance of several very heavy viaducts. The difference in cost of operation will be scarcely appreciable, as there is, first, a direct saving in distance of 3½ miles, while against 20½ miles of a nearly uniform gradient of 1 in 70 with sharp curves, there will be 10 miles of 1 in 40 also with sharp curves, but 6½ miles of generally easy gradients and curves with long lengths of straight; and if there be a slight difference in this respect in favour of the upper line, it is as nothing if the interest on the amount saved from the Capital outlay be put in the opposite scale. We consider it a matter of the highest importance to get rid of the enormously high viaducts on sharp curves, which would not only be difficult to erect, but would always be a source of anxiety, especially in a country subject to earthquakes and violent storms. The grade of 1 in 40 being concentrated in one short length may be economically worked by an assistant engine, so that this cannot be considered the ruling grade, and the weight of trains may be fixed with reference to the real ruling gradient of 1 in 70.

Modifications of this alternative.

18. This alternative may be slightly modified, and an easier gradient of about 1 in 45 be obtained, by winding the line round the head of the valley beyond the saddle; or again by commencing the sharp ascent a mile back from a point opposite the Lokashah, a uniform grade of 1 in 44 may be obtained instead of 1 in 40; or by combining the two modifications, a gradient of close on 1 in 50 would be possible.

NO. 2 DIVISION.

Jatinga Saddle to Mahur Saddle.

Length and estimated cost of section.

19. This extends from the Jatinga saddle to the saddle at the head of the Tawi branch of the Mahur; the length is 18·888 miles and the estimated cost Rs. 24,23,704 or Rs. 1,28,320 per mile, a close approximation to my preliminary estimate for this section of Rs. 1,30,000 per mile.

The line is carried round what I have termed the Haflong spur, on generally descending gradients, but none steeper than 1 in 70, until the Dyung river is reached; this portion is 11¾ miles long: the line then crosses to the right bank of the Dyung by a bridge of 3 spans of 100 feet, and 3 of 40 feet, and ascends steadily with a gradient of 1 in 70 for 7 miles up to the Mahur saddle; a short length of level only being introduced near the head for a station.

Reasons for alignment adopted.

20. On the whole division there is only one stream of any importance crossed, and that is the Dyung, and the spans of the bridge have been fixed to suit the configuration of the ground. In passing round the Haflong spur, which separates the Dyung from its tributary the Aboijee, the watershed is close to the line, and the same is the case after the Dyung is crossed : here, if the line were carried along the left bank of the Dyung, the work would be enormously increased, both on account of the more broken nature of the ground, and the much greater amount of waterway that would require to be provided to pass the drainage from the high and comparatively distant Barail range, which intercepts and precipitates the rain borne forward by the south-west monsoon : the mean annual rainfall on this range may be taken at 200 inches, whereas at Gunjong on the watershed between the Dyung and Mahur about 50 inches only are registered.

Effects of the points on gradients.

21. Between the Jatinga saddle and the Dyung there are certain points where the features of the ground determine the neighbouring gradients: examples of this are found at chains 96 to 114, and 522 to 530; in the former case, to avoid very heavy work, the line is carried into a side valley, but this is very narrow, and the level at which the maximum 10° curve can be economically fitted in is practically fixed; this curve forms a complete horse-shoe carried round at one level, with gradients on each side of 1 in 100 and 1 in 70, but the latter may be eased at the expense of the level on the curve; in the latter case the line cuts into a perpendicular scarp overhanging the Dyung, the level being fixed by the gradient of 1 in 70 between this point and the Dyung viaduct, the height of which has been determined after some trials as to which gave the best result. Tunnelling on this division amounts to 1,066 lineal feet, divided between two tunnels.

Good site for engine-changing station.

22. There is a very good site for a station at the nose of the Haflong spur in mile 307, and if an engine-changing station is required in the hills, this would be a better site as regards the health of the staff than the only alternative sites in the Mahur valley, which are comparatively low and confined.

No. 3 Division.

Mahur Saddle to Mahur Mupa Saddle.

Direct descent into bottom of Mahur valley at junction of Tawi not practicable with grade of 1 in 70.

23. A great deal of labour was expended before the ruling gradient of 1 in 70 was secured between the Mahur saddle and the junction of the Tawi and Mahur. Below this junction the natural fall of the Mahur valley is for about 3 miles equal to the ruling gradient of 1 in 70, and as the bottom of the valley is favourable, while the hill sides are broken and in places precipitous, with considerable streams at intervals, it became an object of the greatest importance, that the line should strike the bottom of the valley near this point. Traverses were run down both sides of the Tawi valley as shewn in the plans, but the left side, as was anticipated, was found in every respect the best.

Manner in which 1 in 70 grade has been obtained.

24. The distance for a direct line was only about 4 miles, while the height to be overcome, taking formation level at the saddle as 1,836 feet, and at the junction as 1,336 feet, was 500 feet, necessitating a gradient of about 1 in 40. Distance was not gained in the bays on the hillside nearly to the extent expected, but a long spur, terminating in a conical hill, exists on the left bank of the Mahur about a mile below the mouth of the Tawi, which gives the means of extending the base sufficiently to secure the grade of 1 in 70, without having recourse to a reversing station. The only other alternative, adhering to this as the ruling gradient, would have been to keep to the hillside, but the cost of so doing would have been prohibitory. The result of taking advantage of this spur is, that the line makes a double loop and the distance is thereby increased from 4 to 6·72 miles, the cost of which amounts to Rs. 11,17,374, or Rs. 1,66,276 per mile, adopting limiting curves of 573 feet radius. The effect of using curves of 400 feet radius on the same gradient at four points, aggregating about four miles on this portion would be to reduce the estimate to Rs. 8,95,600, a saving of Rs. 2,21,774, without affecting the length.

Heaviest work in division is at head of the Mahur or in the Tawi valley.

25. The heaviest work between the Mahur and Mahur-Mupa saddles, a length of 17·83 miles, falls in this short section. There are six tunnels with a total length of 3,456 feet including that at the head, a portion of which, however, is included in the 2nd division. There are several considerable ravines, but it has been found both practicable and cheaper to bank them, and pass the water through culverts at a high level, than to span them by viaducts, the amount of waterway absolutely necessary being very small, as the watershed runs parallel, and close to the line.

Modifications in finally grading line.

26. A uniform gradient has been adopted, but in finally setting out the line, in order to equalise the resistance to traction, it will no doubt be better to ease the gradient on curves at the expense of that on the straights.

Alternative proposed.

27. An alternative line with a uniform gradient of 1 in 45, and the same limiting curve of 573 feet radius has been laid down on the plan, and the cost approximately estimated only, for want of time. Starting from the Mahur saddle, it joins the previous line at chain 417, its own chainage being 267, thus effecting a saving in length of 150 chains, and in cost of Rs. 5,30,740. The difference in cost is due chiefly to the saving in mileage, but also in a considerable measure to the fact, that as the line falls more rapidly, it sooner reaches the more favourable ground which skirts the bottom of the hills, where the ravines are not so deep and spurs have easier contours; the tunnelling is considerably lessened and aggregates 2,421 feet only against 3,456 feet given above. For reasons apparent from the above remarks, the proportion of straight to curve is greater than on the high level line.

Lower Mahur Section.

28. Below the Tawi mouth the line adheres to the right bank of the Mahur for the remainder of the distance comprised in this Division, that is until it reaches the Mahur-Mupa watershed at mile 335, where work was first commenced in these hills in the cold season of 1883-84. For the first 150 chains the gradient of 1 in 70 is generally maintained; a length of 18 chains however is interpolated at mile 325 for a station. For the remaining 8¼ miles gradients are generally easy, the ruling grade of 1 in 70 being introduced for 24½ chains only, which is necessiated in order to keep formation well above flood at a point where the valley narrows and the water consequently heads up. Formation generally has been fixed with reference to an extreme height which it is believed the Mahur floods can reach, for no very accurate data on this point can be obtained, and an extra allowance has been given wherever the width of the valley is restricted. Curves also are generally fairly easy, the limiting curve of 573 feet radius being seldom found necessary. At mile 331 a length of 16½ chains of level is allowed for a station; here the hills recede for some distance from the river, and form a comparatively wide and level bay, known by the name Moibong: this formed the site of the old capital of the Cachari Rajahs after they retired from Dimapur, and remains of old brick walls,

buildings, wells and tanks are still to be seen. A short distance below mile 333 the Mahur turns sharp to the right through a gorge, but the line takes advantage of a narrow depression in the hills, through which it passes by a tunnel 135 feet long into a small subsidiary valley, and after about half a mile again approaches close to the Mahur. From the Tawi down to this tunnel the ground is, on the whole, very easy, but the drainage crossed is much heavier than on the upper section, although, owing to the fact that the bulk of the water is passed in a few comparatively large streams, the cost per mile for bridging amounts to only Rs. 3,000 more. The lowest point of formation in the Mahur valley, the reduced level of which is 834 feet, is reached at mile 334; from this the line ascends in 48 chains with a uniform grade of 1 in 100 to the Mahur-Mupa watershed, where the reduced level of formation is 882 feet.

Length and cost of division.

29. The total cost of this division, 17·83 miles long, is Rs. 20,35,554, or Rs. 1,14,164 per mile. The lower portion therefore 11·11 miles, the estimated cost of which amounts to Rs. 9,18,180, a mean mileage rate of Rs. 82,644.

Economy effected in minor bridging and traverse in the hills generally marked by cairns.

30. In estimating for minor bridging, economy has been studied by placing the culverts at a high level up the sides of the ravines, wherever the character of the ground did not absolutely forbid it, and such cases are confined to the Jatinga valley. Stone cairns or earthen mounds have been built at salient points on the traverses throughout the hills. With these points, marked on the plans, it will not be difficult to pick up the traverses at any future time.

No. 4 DIVISION.

Brahmaputra Valley, Disang Section.

Section along right bank of Disang.

31. During 1884-85, a traverse was run from Golaghat to Dibrugarh, and an alternative to Makum junction, with the exception of a section on this alternative which I stated was so particularly easy that after having gone over most of the ground personally, I could give an estimate which could not be far from the mark. This link has now been filled in; it is 24·94 miles long and the estimate amounts to only Rs 47,305 per mile, a lower rate by far than for any other section of corresponding length; the ground is high, comparatively level, and there is practically no water to pass.

Length and cost of section from Kamarband Ali to Makum junction of which above forms part.

32. The following was the estimate of 1885 for the section from Kamarband Ali to Makum junction. Length 116·7 miles. Cost Rs. 78,39,202, or Rs. 67,174 per mile.

The final estimate stands as under—Length 116·58 miles. Cost Rs. 76,92,286 or Rs. 65,983 per mile.

The advantages of this line, as compared with a direct line to Dibrugarh, were detailed in last year's report.

Roha-Gauhati Section.

Branch Lumding to Gauhati.

33. The only remaining work was the completion of the survey of the branch line from Lumding to Gauhati; the portion between Lumding and the village of Degulihati near Roha was surveyed during the cold season of 1883-84; it is 56·715 miles long and is estimated to cost Rs. 40,06,354. The remaining section from Degulihati to Gauhati is 53·788 miles, the estimated cost of which amounts to Rs. 43,92,408, or Rs. 81,661 per mile: this is a very much higher rate than either Mr. Molesworth or I anticipated, and the excess is almost entirely due to the one item earthwork; the quantities in bank and cutting being equal to a mean height of embankment of over 11 feet, whereas it was considered that a mean of 6 to 7 feet might be taken. The great height of embankment is necessary to keep formation above the Brahmaputra floods, the effect of which on the estimate a cursory examination could not possibly enable one to judge, especially in so flat a country, and in fact only levels could accurately determine it.

Line shorter than trunk road.

34. Between Degulihati and the 24th mile from Gauhati, the railway is 5 miles shorter than the trunk road, but from the 24th mile into Gauhati the former loses one mile, so that the difference on the whole is four miles.

Considerations affecting alignment, &c.

35. Two points chiefly determine the alignment, first the crossing of the Kopili river and the second the passage through the hills between the Digru river and Gauhati. It is desirable to cross the Kopili below the point where it receives its last affluent, the Umiam, by which a separate bridge for that considerable stream is saved, and a long detour such as the trunk road makes is avoided, this fixes the first point approximately, then comes the passage through the hills. Near the trunk road the hills are quite impracticable for any thing but a mountain railway, but attention had been called to a passage near the Amchong tea garden, and an officer deputed to examine it declared it to be quite feasible; when, however, a line was laid down, it was found that the maximum gradient of 1 in 150 adopted in the plains, could

only be maintained at the expense of a tunnel nearly a mile long, and that very heavy works would be entailed even with a gradient of 1 in 40.

Passage through hills west of the Digru river.

36. I therefore personally examined the hills up to their northern extremity near the Brahmaputra, and found that there was only one point through which a line could be taken, and that the only other alternative was to carry it round the northern extremity of the hills, and then to work along the slopes which descend into the Kallang river, but there were the following objections to this course, (1) it would add 2 miles to the length, (2) there would still remain as heavy work in cutting through the spurs on the bank of the Killang, (3) it would involve great damage to the Chandrapur tea garden, and complete demolition of the tea houses and coolie lines. I therefore had no hesitation in coming to the determination to adopt the passage through the hills which lies a short distance above the mouth of the Digru river, seeing it so short and that even with the gradient of 1 in 150 there is only one heavy cutting within a length of 40 chains.

Large streams.

37. In the entire section only two large streams are encountered, the Kopili and Digru; the former is crossed about 4 miles above its junction with the Kallang. It receives the entire northern drainage of the North Cachar hills, and that of the Khasi-Jaintia hills to a point west of Shillong and also of the portion of the Mekir hills which occupies the south-western and the south-eastern angles of the Naga hills and Nowgong districts; the drainage area above the railway crossing is estimated to be 6,153 square miles; the actual width of the river between banks is only 350 feet, but when in flood, it spills over the surrounding country or aids in raising the level of the Brahmaputra inundations: the question of waterway is scarcely soluble by ordinary methods, and the waterway allowed 15—100-feet spans may be considered rather tentative than exact, though the ordinary methods have, to a certain extent, been employed in fixing it, to permit of ready extension; if the waterway is not sufficient, a pier abutment is provided in the estimates at one end; this is a contingency which is very likely to arise, as the country becomes further settled and denuded of forest. The Kopili bridge is next to the Pheni, the longest in the scheme. For the Digru 7 spans of 100 feet have been allowed, and the design on which the estimate is based is the same as for the Kopili, and for the othe large bridges generally in the Brahmaputra valley, with slight modifications to suit any special features. In the case of both these bridges, the roadway is carried on the bottom boom of the girders to give headway for boats with reduced formation level; the substructure is brick with either wells or open foundations, according to position: in the Digru all the piers are on wells, whereas in the Kopili seven are on wells, and the remainder are designed to be buil solid to a level of 10 feet below bed of river, the well piers are thus carried 250 feet back from the river bank under the idea that with the restriction of the water the river may erode and widen its banks, but that this action can never extend so far as to reach the solid piers, which even should it happen, would be tolerably safe without any further special precautions to protect them: the banks of the Kopili are generally good stiff clay.

Heavy embankment.

38. The country generally for some miles above Roha to the hills on the left bank of the Digru is liable at intervals to heavy inundations from the Brahmaputra, to which the above two rivers add their respective quotas: where such is the case formation has been kept about 3 feet above the highest floods of which records have been obtained. Where the line runs between the Kopili and the Kallang no small openings have been allowed in the embankment as I consider they would only be a source of weakness.

Section between Kopili and Digru rivers.

39. Three miles after the Kopili is crossed the line approaches the base of the Khasi Hills, and here I propose to run an earthen bund between the line and the hills, so as to restrain the overflow of the Umiam and to force all its water through the Kopili bridge. From the point at mile 37 to mile 24 the line is fairly close to the trunk road and the Khasi hills and the waterways required are small: it then turns off and makes for the passage in the hills, crossing the Digru river at mile 15, immediately opposite the entrance, in this length of 8 miles the embankment is heavy and no small openings have been allowed in it, which would permit the Brahmaputra and Kallang flood water to break through. A short distance east of the Digru and on the left bank of the Kallang there is a detached block of hills round which, as the map shows, the Kallang floods find a way; as the floods subside the water drains off, partly directly into the Kallang and partly into the Digru and thence into the Kallang, by small channels; if a continuous embankment is made the flood water is forced into the Kallang and the only way by which it can thereafter find a passage to the south side of the line is through the Digru bridge, and in fixing the waterway this has been taken into consideration. Another crossing higher up the Digru was tried, and a line runs thence along the left side of the river to the passage in the hills: this is shown by a dotted line on the plan, but it has not been adopted as it involves a number of small openings to pass the water from the hills.

Line between the Digru and Gauhati for a short distance on old road.

40. After passing through the hills the line enters on a bay where the ground is low and subject to heavy inundation by the Brahmaputra: in crossing this bay it runs for nearly 2 miles on a road, which is said to have been laid

out with a view to the possibility of its being eventually utilized for a railway, but the cost does not appear to have been carefully considered before the work was commenced and the road was never completed; about 13 miles from Gauhati it becomes lost in the jungle, and within these miles little is adapted for the railway, owing to the very sharp turns which are made; where the railway runs on it for these two miles there is little or no traffic, and the Deputy Commissioner of Kamrup has expressed his readiness to make the whole road over if wanted.

Gauhati station.

41. For the last 10 miles the line is generally protected from the Brahmaputra by low hills, amongst which it winds its way into Gauhati. The site for the terminal station was selected by me in company with the Deputy Commissioner; it is well situated both with respect to the civil station and the bazar, fairly equidistant from the two steamer ghats, and is close to the Shillong road: no site is available actually on the river bank.

Alternative between the Kopili and Digru along left bank of the Kallang.

42. An alternative has been run between the Kopili and the Digru rivers, keeping fairly close to the left bank of the Kallang and detailed estimates for it are also forwarded, with a comparative statement of the two. It effects a saving in distance of 3 miles, but is estimated to cost Rs. 88,850 more, due to heavier embankment, and a third large bridge being necessary. For 14 miles from the Kopili no opening of any kind is allowed in the bank: the traverse keeps between the Kallang and a small channel which helps to carry off the overflow of the Umiam and the drainage of the Khasi Hills; this channel is then crossed by a bridge of 6—60 feet spans, and the line then passes through the block of hills already referred to as lying east of the Digru; these hills in their northern aspect present the appearance of a horse-shoe, the eastern division of which is generally lower and less continuous than the western. The line then passes without any difficulty through the former but has to be carried round the northern extremity of the latter, approaching at this point close to the Kallang, thence it passes across the Digru valley with a high bank.

Objections to alternative.

43. The chief objection in my eyes to this alternative is, that it would prevent what is, in reality, mainly the Brahmaputra flood-water from spreading freely over any thing like the same extent of country which it can do now, and which the line near the Khasi hills will scarcely restrict; and unless plentiful provision in the way of openings were made to allow of this, which would very much increase the estimate, a much greater extent of country would be put under water and villages might be endangered, the line itself at the same time standing in greater danger of being breached. The Kallang, too, acts as a highway for communication, and there neither is, nor can be, any great population north of the river who would be materially benefited by this alignment.

First alignment recommended.

44. The alignment first discussed is that which I recommend, notwithstanding that it is 3 miles longer, and on the whole it passes through a more cultivated country: any traffic from the north side of the Kallang will easily find its way to the stations at Degulihati, Durrumtool and Digru.

Length and cost of complete scheme.

45. Accompanying this will be found a final report which contains a summary of the results of the survey operations: it will be seen that the total length of scheme is 736·143 miles which are estimated to cost Rs. 6,16,23,466, or a mean of Rs. 83,711 per mile, which is not a high rate considering the nature of much of the country.

Concluding remarks.

46. I cannot conclude without recording my appeciation of the manner in which the members of the staff generally have worked, and I would bring specially to notice the services of Messrs. H. W. Clift, E. J. Moore, and W. H. Sherman, Executive Engineers, who have had charge of divisions, and among their assistants of Messrs. A. R. Lilley, Executive Engineer, H. T. Gwyther, temporary Executive Engineer, and Mr. B. A. Maine, Sub-Engineer. The bulk of the men temporarily engaged for the work have also done very well, and have gained experience which cannot fail to be useful to them in the future.

Enclosure No. 7 to P. W. D. Resolution No. 868 R. C. of 1887.

BENGAL-ASSAM RAILWAY.

Final Report by J. W. Buyers, Esq., M.I.C.E., Engineer-in-Chief, on the Survey Operations.

Object of report.

The survey of the Bengal-Assam Railway has, after four years of continuous work, been brought to completion, and the question of routes into the Brahmaputra Valley is now, it is hoped, thoroughly threshed out. The object of this report is to briefly describe the project with the aid of the fuller information which is now possessed, to bring together the results which have been obtained, and to examine the grounds on which are based its claims to support in preference to any other of the schemes which have been proposed.

2. This railway then comprises—

Length and cost of projected railway scheme.

(1) A main line, 575·903 miles long, from the seaport of Chittagong to Makum junction, a station on an existing line of railway in Upper Assam.

(2) branch line of 31·895 miles from Laksham to Chandpur ; this leaves the main line in the 80th mile from Chittagong.

(3) A branch from Badarpur to Silchar of 17·842 miles, leaving the main line in the 254th mile from Chittagong.

(4) A branch from Lumding to Gauhati, 11 0·503 miles long, taking off from the main line in the $\frac{370\text{th}}{363\text{rd}}$ mile from Chittagong.

The total length of main line and the branches is therefore 736·143 miles.

Appended to the report will be found abstracts of the estimates of the main line and each of the branches, compiled from the detailed estimates which have year by year been presented in sections.

In the following statement the length, total estimated cost, and mean cost per mile of each are tabulated :—

Section.	Length.	Total estimated cost.	Mean rate per mile.	Remarks.
	Miles.	Rs.	Rs.	
(1) Main Line . .	575·903	4,86,59,064	84,492	Where mileage is denoted by two figures as $\frac{370}{363}$, the upper denotes through mileage on the plans, the lower alternative alignment recommended : the exact total difference between the two being 6·51 miles.
(2) Chandpur Branch .	31·895	26,81,477	84,072	
(3) Silchar Branch .	17·842	18,84,163	1,05,603	
(4) Gauhati Branch .	110·503	83,98,762	76,005	
Total .	736·143	6,16,23,466	83,711	

Narrative of preliminary work.

3. The importance of opening out the Brahmaputra Valley by a railway has been long recognised, but the project of which the survey is now completed does not appear to have been the one which first suggested itself ; with the small amount of information, professional at least, available regarding the hills, which form the southern boundary of the valley, it seems natural that operations should at first have been confined to its western outlet, and the construction of the Northern Bengal Railway directed attention particularly to that quarter. Survey parties were for some seasons at work in the country between the Northern Bengal Railway and Gauhati, but the very formidable streams which are encountered have prevented that Railway being extended as yet even so far as the right bank of the Brahmaputra.

The proposal to construct a railway from a point opposite Goalundo through Dacca to Mymensing led in 1877-78 to a reconnaissance being made round the western end of the Garo Hills from Mymensing to opposite Dhubri, and this, as an alternative project to the connection with the Northern Bengal Railway had the recommendation that only one formidable stream, the old Brahmaputra, was crossed. My first work in Assam was directed to deciding the question of the feasibility of extending the Dacca-Mymensingh line across the Garo Hills into the Brahmaputra Valley. Meanwhile attention had been drawn to the wants of the country lying east of the river Megna, in which, though populous and fertile, there was not a single mile of railway, and it had been pointed out that it might be found practicable to extend a line through these districts across the North Cachar Hills into the Brahmaputra Valley ; thus the idea of the present scheme was gradually evolved. Towards the close of 1882 the Government of India recognising the urgency of the claims of these districts, and the importance of settling the question of the best route into the Brahmaputra Valley, took the matter in hand, and ordered a thorough reconnaissance of the North Cachar Hills to be made in connection with the location of a line from Chittagong to Silchar. During the ensuing cold season this work was accomplished, a feasible route through the hills was discovered, and when it was subsequently examined by Mr. Molesworth, Consulting Engineer to the Government of India for State Railways, the results were approved and confirmed.

Mymensing connection condemned.

4. The advantages of thus connecting the Brahmaputra Valley with Eastern Bengal were so great and obvious that they at once gave the death blow to the connection with Mymensing,

either by the route through or round the Garo Hills ; and the results obtained from the preliminary examination of the country were deemed sufficiently satisfactory to authorise the prosecution of a detailed survey of the schemes as it now stands.

General nature of country surveyed.

5. The survey between Chittagong and Silchar, including the branch to Chandpur, 303¼ miles long (or 41 per cent. of the total mileage) was finished in one season; while it has taken 3 seasons to do the remaining 432¾ miles; this will help to show the different nature of the work in the two sections: the former lay through a country generally open and highly cultivated; of the latter much was in thick forest, while about 100 miles of it was amongst the rough and densely wooded hills which divide the basins of the Surma or Barak and Brahmaputra rivers, and these 100 miles engaged more than half the strength of the survey parties spread over three years.

Chittagong-Kumilla Section.

6. The survey south of Kumilla was carried out by a party working under the orders of Mr. Horace Bell, as Engineer-in-Chief. The length of this section is 128·56 miles, including the branch to Chandpur, and it is estimated to cost with indirect charges, Rs. 87,335 per mile.

Only one large river is encountered, the Pheni, for which 20—100 feet spans have been allowed; but the country is said to be more or less under water throughout the whole extent, during the rainy season, and the allowances to be made on this account, as well as the heavy terminal works at Chittagong, contribute to swell the estimate.

Very full allowance has been made at Chittagong for the works comprised under the main head "Stations and Buildings," and at the outset it would probably be unnecessary to work up to the full provision; indeed, Mr. Bell has stated that the estimates represent rather what the line may ultimately be expected to cost than the outlay which he would at first recommend.

Description, Kumilla-Badarpur Section.

7. My own work commenced at Kumilla, thence to Silchar; hills form a chief element in determining the alignment. For the first 60 miles the line runs north, skirting the Tipperah Hills, but keeping to British territory, and is laid out so as to avoid crossing the Teetas, a very formidable stream, and, when in flood, several miles broad in many places; it then sweeps round the northern extremity of the Lakhipati range, the name given to the north-western offshoot of the Tipperah Hills, and adopts an easterly course for about 34 miles, crossing two low ranges of hills without any very heavy work; a north-easterly course nearly is then adopted for 39 miles, after which turning more easterly, it passes through a third range of low hills, and emerges on the south bank of the Kooseeara river 237 miles from Chittagong, and about 3 miles west of the civil station of Karimgunj; thence, all the way into Silchar, the line keeps fairly close to the Kooseeara and the Barak, the parent stream of the Kooseeara and the Surma and of their multitudinous offshoots, and about 4 miles before Silchar is reached the fourth range of low hills is crossed.

A large proportion of the country is low and subject to inundation; every endeavour has been made to get the best ground, but a relative degree of success only is attainable; consequently there is a great deal of heavy embankment, and especially at the Silchar end after the Kooseeara is reached. A considerable number of large streams also are encountered, all with one exception, flowing northwards from the Tipperah and Lushai Hills into the Kooseeara and the Barak. For these reasons this section of the line, from Kumilla to Silchar, is not a cheap one, being estimated to cost, exclusive of indirect charges, Rs. 76,596 per mile. The following facts exemplify how slightly the surface of much of the country is raised above sea level even along the railway: north of Kumilla there is a stretch of some miles which is only about 20 feet above mean sea level at Chittagong; at Badarpur, distant by the line 254 miles from Chittagong, it averages less than 60 feet, while low water level in the Barak at this point is only about 27 feet above mean sea level, the highest elevation is in South Sylhet.

Silchar branch.

8. Owing to the extension of the system across the North Cachar hills into the Brahmaputra Valley, and the adoption of Badarpur as the point to cross the Barak river, the section between Badarpur and Silchar becomes a branch. It will be noted that this branch is 17·842 miles long, and that it is estimated to cost Rs. 18,84,163, or Rs. 1,05,603 per mile: this rate is due to the high embankment required to keep formation above the Barak floods, and the great amount of drainage crossing the line for which waterway has to be provided. As I do not consider that any advantage at all commensurate with the cost is to be gained by this branch in itself, I recommend that the construction be deferred, at least until the main line has had time to develop the full effects of its operation; the reasons are more fully set forth in paragraph 43 of my report on the survey between Kumilla and Cachar during the season 1882-83, and it is also the recommendation of the Consulting Engineer, Mr. Molesworth. If a feasible route can be found through the hills which separate Cachar from Burma, this branch from Badarpur, or, perhaps better, one from Bikarampur engine-changing station at mile 263, may eventually form a portion of a connection between the Assam and Burma Railway systems.

Possible feeder line.

9. There are some points from which it may be desirable to throw out feeder lines: the two which suggest themselves to me as of the greatest importance are (1) from either Nayanpur or Kusbah stations (respectively at miles 111 and 117) to the bank of the Megna below the junction of the Teetas, which is not far from Bhairab Bazaar, and (2) from Kalaoora station, mile 205, to Fenchugunj, and perhaps on to Sylhet and Companygunj: the former would traverse a rich and populous country producing a considerable quantity of jute which holds a high reputation in the market, and it would probably bring to the main line a large accession of traffic from the position of its terminus on the Megna, and the latter would tap the centre of Sylhet and give communication with the Khasi-Jaintia Hills.

Barak river at Badarpur.

10. It is proposed that the main line shall cross the Barak river not at the Badarpur fort, as first intended, but about seven chains lower down, owing to the unsatisfactory results which have been obtained from the borings at the former crossing. The design for the bridge provides for two central spans, each 250 feet long, and two side spans of 200 feet: the piers consist of steel trestles 50 feet high, each complete trestle resting on a couple of brick wells, 23 feet diameter, sunk 76 feet into the bed of the river. This bridge, from the size of the spans and its height, is the most important individual structure on the line, and, with 900 lineal feet waterway is estimated to cost Rs. 6,60,825. These figures may be compared with the corresponding ones for the 3 longest bridges on the system, *viz.*, the Pheni, which, with 2,000 lineal feet waterway, is estimated to cost Rs. 6,51,000; the Dihing at Jaipur, 1,000 lineal feet waterway, and cost Rs. 3,81,492; and the Kopili 1,500 lineal feet waterway, cost Rs. 4,96,552. But the above does not represent all that is required to pass the Barak water, for on the north side there are two bridges, each consisting of 5 spans of 60 feet, together estimated to cost Rs. 1,08,254, which are required to take the spill. This river has probably the largest discharge of any crossed by the line, but the exact amount would be difficult to arrive at from the manner in which it spills over the country and the whole of its catchment area does not lie within the topographical surveys; the mean annual rainfall is heavier over its area than over any corresponding area in the Brahmaputra valley which affects the line.

General remarks on the North Cachar Hills section and comparison with preliminary estimate.

11. Within the limits of this report a few facts only can be brought together regarding the work in the north Cachar Hills. An index map and section of this portion of the line is attached to this report. The detailed survey has confirmed, quite as closely as could have been expected, the anticipations formed from the preliminary examination of the country. The hill section was assumed to commence 11 miles from Badarpur, and to terminate near the Lumding river, 114 miles from Badarpur, the length thus being 103 miles: the actual distance, on the same alignment, between these points is 104·565 miles: a ruling gradient of about 1 in 70 was expected, and it is proved that this can be obtained, if it is considered worth paying for: the estimate of Rs. 1,30,000 per mile was based on a comparison with a short section surveyed on the Garo Hills in which limiting curves of 400 feet radius were employed, and with such curves this mean rate there can be little doubt would not be exceeded. The traverses have in the first place been run with the object of securing the gradient of 1 in 70, but in laying down a line on the plans the minimum radius of curvature employed has been 573 feet, and with these limiting gradients and curves the estimate for the 104·565 miles has worked out to Rs. 1,55,55,414, which gives a mean mileage rate of Rs. 1,48,763. No doubt with more time we should have been able to make improvements in the alignment with the result of reducing these amounts, and it would be possible to go on elaborating for some time before it could be confidently asserted that little further in this way could be done; but I am aware that the Government of India are anxious to have the work at an early date, and we have therefore had to be content this season with a few days only to lay down the lines, so as to permit the tedious work of estimation to be put in hand. I should have been glad if we could have laid down and estimated for a continuous line with limiting curves of about 400 feet radius, in the same way as has been done with the line with curves of 573 feet radius, but time has only allowed us to try the effect of using these at certain points in the upper parts of the Jatinga and Mahur Valleys, and they reduce the estimate by Rs. 10,41,928, justifying my remark that, were they introduced throughout as the limiting curves, the mean mileage rate would not exceed Rs. 1,30,000. It will be seen in the accompanying report, dealing in detail with last season's operations, that there are two points, one in the Jatinga Valley and the other at the head of the Mahur Valley, where I recommend a departure from the gradient of 1 in 70, and the adoption of stiffer gradients, entailing an alteration also of alignment, which effects a reduction, in the first case of 3·62 miles in distance and of Rs. 28,74,884 in cost, and the latter of 2·89 miles and Rs. 5,30,740; making allowance for which the total length of the hill section will be 98·055 instead of 104·565 miles and the cost Rs. 1,21,49,790 instead of Rs. 1,55,55,414: the lower figures have been adopted in framing the totals of length and cost given in paragraph 2.

Watersheds and drainage crossed with greatest elevations attained.

12. In traversing the hills the line crosses five main watersheds, which separate what, with reference to it, may be called six main systems of drainage, *viz.*, the Jatinga, the Dyung, the Mahur, the Mupa, the Langting, and the Lumding; the first alone flowing south into the Barak, while the remaining five, after unit-

ing to form one stream to which the Dyung gives its name, find their way into the Kopili, and thence into the Brahmaputra. Low and narrow saddles are selected in these watersheds at which to cross, the hills on each side generally rising to a much greater height. The line reaches its maximum elevation at the saddle at the head of the Jatinga, mile $\frac{298\frac{1}{2}}{294\cdot 8}$, where the reduced level of the formation is 1,863, the summit of the saddle being 80 feet higher; but the same level is nearly attained in crossing the watershed between the Dyung and Mahur, at mile 317, where formation is 1,836, and the summit of the saddle is 2,112 feet, being therefore 169 feet higher than the Jatinga saddle.

Description of work in Jatinga Valley.

13. The long valley of the Jatinga gives the means of effecting the ascent of the first watershed, and in it the heaviest work is encountered. The southern face of the hills receives the full force of the monsoon and a heavier rainfall, and it is therefore scoured into deep ravines which are often separated by sharp spurs. To reduce the number of tunnels, and of long and lofty viaducts, thereby effecting a great reduction in cost, a line should be kept as long as possible near the base of the hills. The Jatinga valley is entered by a short tunnel in mile 268, with reduced level of formation 155, the line for the previous three miles having traversed a narrow but easy valley; thence it falls 40 feet in about a mile, after which the ascent may fairly be said to begin. At mile 276½ reduced level of formation is 285, shewing a rise of 170 feet in 7½ miles, effected with varying gradients to suit the configuration of the ground, but none steeper than 1 in 70, and these are comparatively few and short. From near mile 276½ to mile 278, near the mouth of the Kayeng, there is a continuous rising gradient of 1 in 70; the latter may be considered a tie point, and from this, still adhering to the right bank of the Jatinga, there is a choice of alignment up to the saddle, dependent on the limiting gradient adopted; if a gradient of 1 in 70, or any gradient easier than about 1 in 60, be desired, the line must turn up the valley of the Kayeng, and thereby gain the easier grade at the expense of increased length; or the direct ascent can be accomplished by either one of two ways: *viz.*, by a steady gradient of about 1 in 60, with only sufficient level for stations, or by continuing along the base of the hill with easy gradients for nearly 6 miles, and thence a sharp ascent. The intermediate course has nothing to recommend it, except that it would save about 3½ miles, and the amount paid for this in winding round the Kayeng valley with the grade of 1 in 70, and, mile for mile, it would cost at least as much; but the latter course in addition to saving 3½ miles effects a reduction of cost of nearly 29 lakhs rupees. This is the course recommended. A line has been surveyed on it for 6½ miles beyond mile 278 and from the termination the ascent can be effected with a gradient of 1 in 40. The distance from mile 278 to the saddle by the nearly continuous 1 in 70 grade is 20·44 miles, which are estimated to cost Rs. 57,52,362; between the same points by the lower line the distance is 16·82 miles, and the cost Rs. 28,77,478, which vast reduction is due chiefly to the fact that the lower 6½ miles avoids several extremely heavy viaducts, and a considerable amount of tunnelling. This subject is more fully discussed in the accompanying report, and the remarks on this question contained in the two reports may be read together.

Section between Jatinga and Mahur saddle.

14. The saddle through which the line quits the Jatinga valley separates that from the Aboijee, a tributary of the Dyung: the saddle at the extreme head of the Jatinga, about two miles higher up, is nearly 150 feet higher and leads into almost impracticable ground. The line descends to the Dyung river, winding round the Haflong spur, which separates the Aboijee from the Dyung; the descent of 543 feet is accomplished in 11¾ miles, a mean fall of 46 feet per mile: the gradients, therefore, are generally fairly easy, but there are two tiepoints at the bottom which necessitate the adoption of the 1 in 70 grade for the 93 chains which intervene. The Dyung is spanned by a viaduct of 3 spans of 100 feet and 3 of 40 feet, the extreme height in centre above of stream being 105 feet. From the Dyung there is, with the exception of one short length for a station, a continuous grade of 1 in 70 for 7·17 miles up to the saddle between the Dyung and the Tawi, a branch of the Mahur. The length between the Jatinga and Mahur saddles is 18·888 miles and the estimated cost Rs. 24,23,704, which gives a mean rate of Rs. 1,28,320 per mile against my preliminary estimate for the same section of Rs. 1,30,000 per mile.

Section between Mahur and Mahur-Mupa saddle.

15. From the Mahur saddle the descent is effected along the left side of the Tawi Valley to the point where that stream joins the Mahur, below which the mean valley has for about 3 miles itself a fall of 1 in 70. Here again there is a choice of gradient, to effect the descent direct to a point about one mile below the junction of the two streams, a uniform gradient of 1 in 45 is required for 5 miles, whereas the gradient of 1 in 70 can only be obtained by forming a loop in the line, which the plan shews, and which extends the length from 5 to 7·89 miles. This is the second point referred to in paragraph 11, from which considerable economy can be obtained by departing from the grade of 1 in 70. The 7·89 miles with limiting curves of 573 feet radius are estimated to cost Rs. 12,30,740, whereas the estimate for the 5 miles amounts to Rs. 7,00,000, the difference being due partly to mileage and partly to causes detailed when treating of the work in the Jatinga valley, though here, on the upper or longer line, there are no heavy viaducts which it is important to avoid. The effect of curves of

400 feet radius on the upper line has been estimated to save Rs. 2,21,774, equivalent to 18 per cent. The two lines unite on the right bank of the Mahur at mile $\frac{362\frac{1}{4}}{318\frac{1}{4}}$ and the Mahur-Mupa saddle is reached at mile $\frac{335}{328\frac{1}{4}}$. In these 10 miles approximately there is not much calling for special mention; for the first 7 miles there is no heavy work: the grade of 1 in 70 is only used to a limited extent and easy curves are generally employed; much of the ground is very level. Below mile $\frac{333}{326}$ the Mahur turns at right angles through a gorge, but heavy work is avoided by carrying the line through a low and extremely narrow depression which exists in the hills a short distance above. The point selected for crossing the Mahur-Mupa watershed is low and the ascent to it from the Mahur valley is effected in 48 chains with a uniform gradient of 1 in 100. Formation level here is 882 feet.

Muppa valley section.

16. Hence to the saddle at the head of the Dijakho, lower down and on the opposite side of the Mupa valley, is about 6½ miles; and this section is estimated to cost Rs. 12,00,314, or Rs. 1,80,052 per mile, my preliminary estimate having been Rs. 1,80,000 per mile; it is, as I said, the heaviest section out of the Jatinga valley. The line runs sharp down with the gradient of 1 in 70 to the Mupa river, and after crossing to the right bank keeps along it for nearly 3 miles, when the Boila, a tributary, as large as the Mupa itself, is reached, it then sweeps round into a side valley, and has a sharp ascent for a mile, piercing the Dijakho saddle by a tunnel, and in this mile there are altogether four tunnels, the aggregate length of which is 1,590 feet. The viaducts across the Mupa and Boila are considerable structures respectively, 302 feet and 474 feet long and 76 feet and 120½ feet high at the centres.

Section between Dijakho and Langladisa saddle.

17. From the Dijakho saddle the line descends to the Langting river, which is crossed by a bridge of 4-60 feet spans at mile $\frac{348}{341\frac{1}{2}}$, and then after mounting by a short ascent and descent over a spur which divides the Langting from its small tributary the Lamong it climbs up to the watershed which parts the drainage of the Langting and the Langladisa, which is reached at mile $\frac{356}{349\frac{1}{2}}$: the ascent is partly effected by a continuous grade of 1 in 70 for 185½ chains. This section of 14½ miles nearly is estimated to cost Rs. 16,01,204, or Rs. 1,10,580 per mile; the work is not very formidable.

Langladisa valley section.

18. After passing the Langladisa saddle the work becomes light, and the gradients generally are easy and a few facts will shew clearly how favourable are the results which the Langladisa valley has given. From the saddle to the point near the Lumding river where the Assam valley traverse is joined is 12·9 miles: on this length the gradient of 1 in 70 is only employed for 35 chains; there is only one major bridge of 3-60 feet spans across the Lumding river, into which the Langladisa drains; not a single tunnel, and the estimated cost only amounts to Rs. 68,277 per mile; the valley, too, has a very direct course, though narrow, and in fact so favourable is it that these 13 miles can scarcely be classed as a hill line.

Effect of characteristic features of country on estimates.

19. The saddle at the head of the Mahur may be taken as the centre of the hill section, and the following statement may be of interest as shewing how the two halves contrast with each other:—

Sections.		Miles with no gradient steeper than 1 in 70.	Cost.	Miles with the grade of 1 in 40 and 1 in 45 at two points.	Cost.
			Rs.		Rs.
SOUTHERN .	Mile 11 from Badarpur to Mahur saddle . .	52·707	98,37,572	49·087	69,62,688
NORTHERN .	Mahur saddle to junction with the Assam valley traverse	51·858	57,17,842	48·968	51,87,102
	Total .	104·565	1,55,55,414	98·055	1,21,49,790

The great excess in cost of the southern half points to what are some of the most prominent features in the conformation of the great range which separates the basins of the Surma and the Brahmaputra, such as the more rugged and precipitous nature of the southern face, and of the propinquity to it of the main watershed and of the greatest elevations; rising abruptly from the alluvial plains on the south, the range falls gradually towards the north, and it is the ascent of the southern face that everywhere presents the greatest difficulty. The distance from mile 11 to the Jatinga saddle, by the alignment in which the maximum gradient of 1 in 70 and limiting curves of 573 feet radius are used, is 33·819 miles and the estimated cost is Rs. 74,13,868, from the Jatinga saddle to the Lumding junction with the same limiting gradients and curves, is 70·746 miles and estimated cost Rs. 81,41,576; for this latter section my preliminary estimate gave 71 miles and Rs. 78,40,000, which therefore exceeds the actual distance by only a quarter of a mile, but is less than the final estimate by 3 lakhs of rupees; but it has been shewn how this difference may be reduced by nearly 2¼ lakhs rupees by employing curves of 400 feet radius over a short section at the head of the Mahur. The above figures give a mean mileage rate of Rs. 2,19,222 for the 33·819 miles, and of Rs. 1,15,081 for the 70·746 miles, or the ascent of the southern face costs nearly double, mile for mile, than that of the northern descent, and there is less than half the distance to accomplish it in: with the 1 in 40 and 1 in 45 gradients interpolated at two places the figures are respectively as follows:—

Section.	Length in miles.	Estimated cost.	Mean mileage rates.
		Rs.	Rs.
Southern	30·199	45,38,984	1,50,302
Northern	67·856	76,10,806	1,12,161

Here the mileage of the southern section remains as before less than half that of the northern, but the introduction of the 1 in 40 grade has greatly reduced the cost.

Remarks on engine-changing stations and gradients.

20. An engine-changing station is provided at Bikrampur, 9 miles from Badarpur, and near the foot of the hills; and another on the north side at Lumding junction. I consider an intermediate engine station will be required in the hills, and the best point for it is at the nose of the Haflong spur, mile $\frac{306\frac{1}{2}}{303}$; the only alternative site would be in the Mahur valley; both are about equally distant from being quite central, but the former would no doubt be healthier for the staff from its elevated situation, and water is reported good and plentiful. I do not attach much importance to any saving from departure from the 1 in 70 grade at the head of the Mahur valley: the 1 in 40 grade in the Jatinga valley is concentrated and can be worked with the aid of an assistant engine, and the weights of trains can be fixed with reference to the 1 in 70 grade, which will thus remain the true ruling gradient of the hill line.

Lumding to Dimapur.

21. From Lumding the main line makes for Dimapur, which is reached in mile $\frac{416}{409}$; here a road leads off to Kohima, the head-quarters of the Nága Hills district. The country between Lumding and Dimapur is broken by low hills and narrow valleys, and the whole covered with heavy forest; but by winding about, a line without any formidable work has been got, the cost of which averages only Rs. 78,800 per mile. The railway parties were the first to traverse this tract of country. The largest bridge on this section is one of 3-100 feet spans across the Langpher river; the rest are insignificant.

Lumding to Kamarbund Ali.

22. North of Dimapur, two lines have been run: the first keeps to the west or left side of the Dhansiri river until it comes opposite Golaghat; the other crosses the Dhansiri about 12 miles north of Dimapur, thence runs between that river and the Daiang for 27 miles, and connects with the first about 6 miles east of Golaghat at mile $\frac{460}{459\frac{1}{2}}$. There is a difference in favour of the latter of 1·65 miles in length, and Rs. 1,89,392 in cost, and although it avoids Golaghat, it is the one recommended and adopted in all calculations. On the first line the Dhansiri is crossed at Golaghat by a bridge of 6 spans of 100 feet, and on the latter the Dhansiri has 3 spans and the Daiang 4 spans of 100 feet. The distance between Lumding and the northern connection of the two lines by the route recommended is 96·643 miles, and the estimated cost Rs. 67,01,270, or Rs. 69,310 per mile. Though forest prevails as far as the Daiang, there are not infrequent signs of old cultivation and habitation, and the soil is rich and well adapted for the cultivation of tea.

Kamarbund Ali to Makum Junction.

23. The line now runs for Nazira, the central station of the Assam Tea Company. In this section of 50 miles there are only two considerable streams, the Disoi and Jhanzi, for which 3 or 4—100 feet spans respectively have been allowed: the work otherwise is easy. Passing Nazira, within the next 16 miles, two important streams, Dikhu and the Disang are crossed, also with 3 and 4—100 feet spans, and the line then enters upon a particularly easy stretch of country which extends for 35 miles until Jaipur is reached at mile $\frac{566}{559\frac{1}{2}}$, when the Dehing is crossed with a bridge of 10—100 feet spans; this is the longest bridge on the main line,

the Pheni excepted, although it will not be nearly so difficult or costly an undertaking as the bridge across the Barak. The line then makes for Makum junction through a country covered with forest, but presenting no engineering difficulties. Between the Daiang and Disang rivers many large tea gardens are passed, and the country generally is fairly cultivated, though there are still one or two considerable belts of forest, but north of the Disang to Makum junction, with the exception of a few miles near Jaipur, comparatively little cultivation of any kind is to be seen, and the gardens are few in number. The total length of the section of line treated of in this paragraph is 116·58 miles, which are estimated to cost Rs. 76,92,286 or Rs. 65,983 per mile. An alternative line was run direct from Nazira to Dibrugarh; the reasons for preparing Makum junction for the terminal station have been fully detailed elsewhere. Although the line to Dibrugarh is 25 miles shorter than the Makum junction line, it is only estimated to cost 6½ lakhs rupees less.

Lengths of plains and hill section.

24. The main line thus consists of 264·625 miles in the plains between Chittagong and the North Cachar Hills; 98·055 miles in the hills; and 213·223 miles in the Assam Valley between Lumding and Makum junction.

Gauhati branch.

Lumding to Degulihati near Roha.

25. The branch from Lumding to Gauhati does not present many features of interest or importance. The section between Lumding and the village of Degulihati, near Roha, was surveyed during the cold season of 1883-84: it is 56·715 miles long and is estimated to cost Rs. 40,06,354, which gives a mean mileage rate of Rs. 70,640. In the report of 1884 which accompanied the estimates, it was stated that the alignment of the first 13 miles from Lumding could be considerably improved; these 13 miles have the heaviest work and are estimated to cost Rs. 1,09,404 per mile. The effects of such improvements will probably be to reduce the mileage rate of the Lumding-Roha Section to Rs. 68,000; but in the statement given in paragraph 2 the actual figures of the estimates, both for this branch as well as for the remainder of the system, have been retained, and no credit has been taken for possible improvements the extent of which is uncertain.

Degulihati to Gauhati.

26. The section between Degulihati and Gauhati was surveyed during the last cold season. It is desirable to cross the Kopili below the point where it receives its last tributary the Umiam, and this also gives the most direct route: the traverse then keeps for 13 miles from Degulihati, between the Kopili and the Kallang and here no small openings have been allowed, as I consider they would be a source of weakness. At the Kopili 15 spans of 100 feet have been allowed; it is thus next to the Pheni the longest bridge in the entire system, and it is quite possible that the waterway given may not be sufficient especially as the increase of population leads to the denudation of the country. The Digru river about 21 miles further west, is the only other stream of any consequence on this section, and 7—100 feet spans are here provided. The position of the crossing of this river is practically fixed by the range of hills which intervene between it and Gauhati: the only feasible passage through these hills lies a short distance above the mouth of the Digru. Between the Kopili and this point two routes are available, both of which have been surveyed, and for which estimates are now submitted: the southernmost line is that which I have recommended, in preference to the one along the bank of the Kallang, which, though three miles shorter, is estimated to cost more. This section is fully described in the accompanying report. The passage through the hills is accomplished in 40 chains, and thereafter the line generally winds among hills all the way to Gauhati. The distance from Degulihati to Gauhati is 53·788 miles, which are estimated to cost Rs. 43,91,408, or Rs. 81,661 per mile; this high rate is chiefly due to the heavy embankment required to keep formation above the Brahmaputra floods.

Levels checked with trigonometrical bench marks.

27. The levels, brought up from Chittagong mean sea level across the North Cachar Hills, have been connected with trigonometrical bench marks at Golaghat and Gauhati, and checked with these to one foot.

Object of line.

28. Such is the large scheme by which it is intended to open out the fertile and populous districts of Bengal and Assam, leaving east of the river Megna, and to render more accessible the distant Brahamaputra Valley, at present sparsely populated, but with rich waste lands awaiting the cultivator; rich also in its undeveloped mineral resources, and in the possession of an industry which has reclaimed from the jungle extensive tracts, and brought wealth of the land which, but for it, would probably have slumbered on for many years, without the thought even of a railway being spent upon it; this tea industry has encountered many difficulties, among the chief of which may be reckoned the want of a free and plentiful supply of cheap labour, and this a railway alone can satisfactorily meet.

Financial aspects.

29. The question then arises, will this scheme pay? In my reports of 1883, on the exploration of the North Cachar Hills, and of the survey between Kumilla and Silchar, attempts were made to answer this question. It was stated that the lowest net return which the

Government of Bengal calculated receiving from the operation of the Chittagong-Kumilla and Chandpur Section without any extension northwards, was 9 per cent., and that such generally was the fertility and populousness of the country between Kumilla and Silchar that 6 per cent. did not seem too much to assume for that section : the figures then for these two sections stood as follows :—

Section.	Miles.	Net return per cent.	
Chittagong-Kumilla and Chandpur .	129	9	
Kumilla-Silchar	175	6	
Total . .	304	7·27	Mean net return.

The question of the extension of the Brahmaputra Valley was then considered in its different bearings. The distance between Badarpur-Dibrugarh and Gauhati was taken at 433 miles, which were estimated to cost Rs. 3,97,90,000, and calculations, framed in part on figures contained in the report on the river-borne trade of the Province of Assam during the year 1881-82, for the Brahmaputra Valley, were given to shew that it was not unreasonable to expect a net return of 2·75 per cent. on the Capital outlay on this section treated independently, it was further stated that the effect of the connection with the Chittagong-Silchar system would be to throw a heavier traffic over the latter, and this was estimated to add 1·85 to the former net returns of 9 and 6 per cent.

The results finally arrived at from the working of the whole system were as under :—

Section.	Miles.	Net Return per cent.	
Chittagong-Kumilla and Chandpur . .	129	10·85	304 miles, 9·12 per cent.
Kumilla-Silchar	175	7·85	
Badarpur-Dibrugarh and Gauhati . .	433	2·75	
Total .	737	5·38	Mean net return.

The fact was not sought to be concealed that these returns were in a great measure based on conjectural estimates, and reasons were given how it could not be otherwise; for some districts there were no trade return whatever; for all there was the uncertainty of the extent to which the Railway would succeed in attracting traffic from the river. Regarding the section south of Silchar I have nothing more to say : at the time the above reports were written that section had been actually surveyed and estimated, and nothing has been done to it since ; but as regards the extension into the Brahmaputra Valley there was the additional element of uncertainty that both the length and cost were conjectural : Dibrugarh was taken for the terminal station in Upper Assam ; it has been altered to Makum Junction : this alone would have added 25 miles, but the detailed survey has effected a reduction in other parts, and instead of 433 miles estimated to cost Rs. 3,97,90,000, the correct figures are 432·781 miles, which are estimated to cost Rs. 3,66,35,378.

A net return of 5 per cent. on the whole system anticipated.

30. Appended to this report is a statement which shews the weights for the main staples of Import and Export of the Brahmaputra Valley between the years of 1881-82 and 1885-86 inclusive, carried both by boat and by steamer on the Brahmaputra river, which for all practical purposes may be regarded as the sole highway, seeing that the traffic which passes in and out of the valley by all other routes combined is quite insignificant. This statement shows that the trade of the valley has made some progress since the railway returns were calculated, and when it is considered that at the best, it must be several years before the railway is completed, during which interval further progress may confidently be anticipated, it seems safe to assume that the estimated return of 2·75 per cent. for the section north of Badarpur, based on the trade of 1881-82 does not err on the side of being a too sanguine one. It seems to me unnecessary to cumber this report with fresh calculations, seeing that so much is unavoidably based on speculation, and I shall therefore leave these figures alone; if the calculations have any value they shew that a net return of upwards of 5 per cent. may be anticipated from the capital outlay on the complete system.

Advantages of the scheme.

31. The advantages which this scheme possesses, or is claimed to possess, as regards the Brahmaputra Valley—and it is unnecessary to go beyond that—may be briefly enumerated.

(1) Economic: as a direct route to Calcutta it possesses, as Mr. Molesworth has remarked, many advantages compared with the route *viâ* Dhubri: it connects the Brahmaputra Valley with the rich and populous districts lying east of the Megna, and gives it unbroken railway communication with the seaport of Chittagong; while the branch to Gauhati furnishes an outlet towards Northern Bengal, and the means of intercommunication within the valley itself.

(2) Administrative: the province of Assam is divided by a range of hills about 100 miles broad, across which there is practically only one road, leading from Gauhati to Sylhet *viâ* Shillong and Cherrapunji, and intercommunication is consequently very tedious; this the railway would entirely alter.

(3) Military: it offers the means whereby troops can be most readily poured into the country and brought into positions which command the whole mountainous districts which separates the province of Assam from Upper Burma and which is inhabited by savage and unruly tribes; while it will enable the troops stationed in Upper Assam and Cachar to render the mutual support which at present they cannot efficiently do.

Preliminary remarks with regard to Mr. Ward's objections to the scheme.

32. I should have been glad to have left the question here, but Mr. Ward has advocated the extension of the line from Gauhati to Fakirgunj, opposite Dhubri, in place of the connection across the North Cachar Hills; or in other words he has advocated two independent systems of railway, one between Chittagong and Silchar and the other confined to the Brahmaputra Valley, instead of the one connected system which this project is intended to give: and as Mr. Ward in his note of September 1885 has stated that he has seen no reply to his arguments against what he calls the North Cachar connection scheme, it seems to me that I may as well treat the question here as make it the subject of a detached note. With reference to Mr. Ward's remark I would note that I considered little good was to be gained by discussing this question further than I had done in my two reports of 1883, except in a very general manner, until the completion of the work should provide me with fuller and more trustworthy data.

I shall endeavour to shew as briefly as possible the grounds on which I differ from Mr. Ward, and I must premise my remarks by saying that I am not conscious of a mind unduly prejudiced in favour of the North Cachar Hills route or filled with a quixotic ambition to run a tilt against engineering difficulties: the question has been to me the subject of very anxious consideration, and I have endeavoured to look at it dispassionately in all its bearings. Had I been able to fall in with Mr. Ward's view from the first, I should have saved all concerned in the survey very much toil and very much discomfort for which they would have been thankful, and all this I fully foresaw. I am only conscious of having had one object in view, *viz.*, to devise a scheme of railway which should be the best for the Province, both in the present and in the future. As years and the progress of the work have furnished me with fuller information and time more thoroughly to consider the question, my opinions have gained strength, but I must regret not having been successful so far in enlisting Mr. Ward's support.

Respective lengths and cost of the connection and of the extension.

33. Mr. Ward in paragraph 7 of his note, dated 29th August 1883, writes—"Mr. Buyers had reminded me that his scheme No. 4 does practically give me all I want, *viz.*, an Assam Valley line. This is perfectly true, and if the Government of India will sanction this scheme I shall have no reason to complain. But it is because I fear it will not be sanctioned that I have proposed in the next paragraph a less expensive scheme." Mr. Ward then goes on to argue in favour of a line down the Assam Valley following generally the Trunk Road. In the following year I examined this Trunk Road route between Gauhati and the Dhansiri river, and the concluding portion of my report on the survey operations of 1883-84 was chiefly devoted to describing it and to detailing my objections to it. Mr. Elliott in the forwarding note with this report stated his objection "to the principle of laying a railway on a Trunk Road under any circumstances," and further expressed his opinion that my arguments were sound, and that the Dimapur Valley route possessed superior claims. I understand Mr. Ward now to have waived his objections on the question of alignment, so that the question between us I take it is now narrowed simply to this—which is of prior importance—the connection across the North Cachar Hills, or the extension from Gauhati to Fakirgunj—it being assumed that at the commencement money would not be forthcoming for both. Mr. Ward would sacrifice the connection in favour of the extension to Fakirgunj. The connection is 109·055 miles and is estimated to cost Rs. 1,38,43,060; the extension is 122 miles, and, if the old figure of Rs. 80,000 per mile be taken in estimating, it will cost Rs. 97,60,000. It is, however, probable that this estimate is too low, for the Government of India have an estimate for the section between Gauhati and Goalpara which gives a rate of Rs. 81,000 per mile for a line laid, for the most part, on the Trunk Road; and the experience gained from the present surveys shews that when any considerable length of line comes within the area of country liable to be inundated by the Brahmaputra, the cost exceeds Rs. 80,000 per mile; we have had two instances of this, *viz.*, in the section between Nazira and Dibrugarh, 40¾ miles, the estimate for which amounts to Rs. 92,311 per mile; and again in the section between Roha and Gauhati, 53¼ miles, with a mileage rate of Rs. 81,661. As between Gauhati and Fakir-

gunj there are proportionately a greater number of large streams than on the Gauhati-Roha Section, the mileage rate is not likely to be less. Allowing, however, the above figures to stand the connection is 13 miles shorter than the extension, but is estimated to cost Rs. 40,83,060 more.

Position of Chittagong with regard to the scheme.

34. It is for the Government of India to decide whether the claims set forth on behalf of the connection are just and warrant the extra expenditure; my own opinion is that the advantages which the connection will confer will be cheaply purchased at such a rate; and that the branch to Gauhati with fast steamers between that place and Dhubri will satisfy all just requirements of the Brahmaputra Valley for some time to come. Mr. Ward disputes these claims; he appears to me practically to deny the importance of having direct railway communication between the Brahmaputra valley and Chittagong, for he notices this point only in connection with my remark that tea may be expected to adopt that route in course of time, and dismisses it with the remark that this is a prospect too remote to affect the question under discussion. The claims of Chittagong may not in my opinion be so lightly set aside. Supposing the scheme to be made as proposed, the position of the Brahmaputra Valley, relatively to Chittagong and to Calcutta taking Lumding as a central point, would be as under:—

Mr. Buyers is quite wrong here. I have to look at the financial as well as the commercial point of view.

(Sd.) W. E. W.

			Miles.
Lumding to Chittagong		. . . .	363
Lumding to Calcutta	(1)	*Viâ* Chandpur and Goalundo . .	533
	(2)	*Viâ* Gauhati, Dubri, Jatrapur and Sara .	585
	(3)	*Viâ* Gauhati, Dubri and Sara if Kaunia and Dhubri are connected by rail .	575

Chittagong then may be taken roughly as 200 miles nearer than Calcutta, and goods would reach it without break of bulk, whereas to Calcutta *viâ* Chandpur and Goalundo they would be subject to two extra transhipments; and *viâ* Gauhati, Dhubri and Sara, to four even with the railway completed between Kaunia and Dhubri; the result could scarcely fail to be that the great bulk of the goods traffic between the Brahmaputra Valley and Calcutta would pass beween Chandpur and Calcutta, or Gauhati and Calcutta by water, and the difference of mileage would be greatly increased in favour of Chittagong but to a much less extent in the case of the Chandpur than in that of the Gauhati route.

I have never contemplated tea going to Calcutta from Goalundo or from Dhubri and Kaunia by rail. What I have contemplated is from Chandpur or Fakirgunj (Dhubri) by river.

(Sd.) W. E. W.

The Commissioner of the Chittagong Division, in a letter dated 11th February 1882, to the Secretary to the Government of Bengal, Public Works Department, states that freights will always be more in the case of Calcutta than in that of Chittagong, the towage and port charges at the latter being infinitely less. Here are surely just and reasonable grounds for anticipating that trade will gravitate towards Chittagong, and for considering the connection with that seaport an important point in favour of the scheme. That Chittagong will become the port for the districts of Eastern Bengal is the expressed conviction of the Bengal Government, and the Brahmaputra Valley will stand in much the same relation to it and to Calcutta that these districts will do. As a port it has already made rapid progress notwithstanding that it has to contend against very faulty internal communications. I have been informed that about 30 per cent. of the tea exported does not pass through the hands of Calcutta brokers, and that there is no reason to doubt but that this would adopt the Chittagong route, and although opinions may be divided regarding the balance, may consider that the keen competition which exists, and the small margin of profit will lead to the early adoption of the cheaper route. Tea is a typical article, and all other goods passing in or out of the port of Calcutta will be subject to the same influences. Mr. Ward's project will not give the Brahmaputra valley any connection with Chittagong and by it the distance from Lumding to Calcutta will be 566 miles *viâ* Dhubri, Jatrapur and Sara; or 558 miles if Kaunia and Dhubri be connected by rail.

When it has become the port for Eastern Bengal it will then be time enough to speak about the North Cachar connection.

(Sd). W. E. W.

Reasons for believing that the connection will bring extra traffic to the Brahmaputra.

35. Mr. Ward again expresses his conviction that the North Cachar Hills connection "will bring no additional traffic to the Assam Valley line that a disconnected Assam Valley line from Dibrugarh to Gauhati and Dhubri would not also bring." The process of reasoning by which this conviction is arrived at is not shewn. I shall merely mention one or two facts which lead me to an opposite conclusion. By the last census reports the population of the districts of Cachar, Sylhet, Tipperah, Noakholly and Chittagong, through all of which the railway would pass, is nearly 6 millions, while the population of Dacca and Mymensing is upwards of 5 millions. The total value of the trade between the Brahmaputra Valley, the population of which is 2¼ millions, and the whole of these districts containing 11 millions, was only valued at Rs. 8,16,815 for the year ending 31st March 1885; to this one article, timber alone contributed nearly 5 lakhs rupees or 61 per

cent.; a truly insignificant trade indeed when the vastness of the population concerned is considered; but to my mind this implies nothing more than faulty communications, for first I find that the whole of this trade was carried by country boats, and to those who know how great are the difficulties which boats have to contend against in navigating the Brahmaputra further explanation is scarcely necessary; and again, confining ourselves simply to the Brahmaputra and Surma Valleys, the trade reports bring out the fact that "the exports of the one are sometimes the imports of the other;" surely a favourable condition for the development of trade. Again, I find that during the same year the districts of the Surma Valley, that is Cachar and Sylhet with their populations of about 2¼ millions carried on with the remaining districts grouped above, that is Tipperah, Noakholly, Chittagong, Dacca and Mymensing, having a population of 8¾ millions, a river trade valued at Rs. 82,31,999; this is accounted for in part of course by their propinquity, but this would not help them so much as it does had they not the great comparative facilities which the easily navigated rivers afford, and if the Brahmaputra Valley is given railway communication with these districts, I can see no reason to doubt but that trade between them will follow. To a great extent of course this will consist simply of a diversion of trade into a new channel; for instance if the Brahmaputra Valley can get from the Chittagong direction what it wants cheaper than from Calcutta or Northern Bengal, it will naturally go in that direction, and the one quarter will gain what the other loses, but this all means impetus to traffic, money saved in one way being available for investment in another, and given improved means of communication between 13 millions of people, who have practically none at present, surely the result would not be *nil*. It would be tedious to go into greater detail, as I could easily do.

Mr. Ward's and projected schemes contrasted.

36. Before going further it may be useful to tabulate for ready reference the mileage and cost of the projected scheme north of Badarpur, and of Mr. Ward's Assam Valley line.

(1) *Projected Scheme.*

Sections.	Miles.	Estimated cost.
		Rs.
Badarpur to Lumding	109·055	1,38,43,060
Lumding to Makum Junction	213·223	1,43,93,556
Lumding to Gauhati	110·503	83,98,762
Total .	432·781	3,66,35,378

(2) Assam Valley Line.

Section.	Miles.	Estimated cost.
		Rs.
Makum Junction to Lumding	213·223	1,43,93,556
Lumding to Gauhati	110·503	83,98,762
Gauhati to Fakirgunj	122·000	97,60,000
Total .	445·726	3,25,52,318

The difference between the two is the same as that already given in paragraph 33. In paragraph 29 it has been stated that a mean net return of 5·38 per cent. was anticipated from the operation of the entire projected scheme of 707 miles: the results obtained from the detailed survey shew that, while mileage is not altered, the estimated cost is reduced, the effect of which will be somewhat to increase the returns; but I shall allow the above figures to stand, and proceed to contrast the working of Mr. Ward's disconnected scheme. The most favourable result that I could work out for this is fully set forth in paragraph 70 of my report of 1883 on the survey of the line between Kumilla and Silchar, and that gave a mean net return of 2·16 per cent. on a Capital outlay of Rs. 3,11,20,000, for a line laid along the Trunk Road 389 miles long. Retaining this net return for the longer length of 446 miles, with its greater Capital outlay, the result from the working of the two disconnected lines will be as under :—

129 miles @ 9 per cent. } 304 miles = 727 per cent. mean.
175 „ @ 6 „ }
446 „ @ 216 „

Total . 750 miles = 4·23 per cent. mean net profit

and in order to earn the same net return as that calculated for the connected system, *viz.*, 5·38 per cent., the Assam Valley line must return 4·69 per cent. instead of 2·16 per cent. If, however, the same net return of 2·75 per cent., which has been taken for the 433 miles of the projected scheme be also taken here, the 750 miles will shew a mean net return of 4·58 per cent. It is inconceivable that the volume of traffic on the 446 miles of Mr. Ward's Assam Valley line will be greater than on the 433 miles of the extension; and the only other alternative that remains to make the results from the operation of the two distinct entire schemes tally is to reduce the percentage of the Chittagong-Silchar Section of the projected scheme which stands at a mean of 9·12 per cent.; this must be reduced in one case to 6·52 per cent., and in the other to 7·38 in order to arrive at the mean of 4·23 or 4·58 per cent. for the total 750 miles, while the mean of the Chittagong-Silchar Section in Mr. Ward's scheme is 7·27 per cent., so that in the one case there would be absolutely a great loss from the connection, and in the other an inappreciable gain. But Mr. Ward acknowledges that the connection will bring additional traffic and also cheap coal to the Chittagong-Silchar line, and I may add that it will otherwise reduce the working expenses, for I need scarcely say that one connected line will be worked more cheaply than two disconnected ones. Mr. Ward's schemes will not mutually benefit one another, nor will a single other railway gain more from them than it will do from the projected scheme.

Question of carriage of tea.

37. Mr. Ward then in paragraph 5 of his note of September 1885 goes on to discuss the question of the carriage of tea from Upper Assam to Calcutta, and after assuming that steamer freight from Chandpur would not be less than from Fakirgunj, arrives at the result that the route *viâ* Fakirgunj would be the cheaper one; if this assumption could be proved to be correct this conclusion would be just, but I shall give my reasons for believing that it will not hold good. Taking Nazira as a convenient control point, the true distances then will be as follows :—

	Miles.
to Chittagong	509
to Chandpur	462
to Fakirgunj	379

and taking ⅓rd pie per maund per mile as the rate of railway freight the through freight on one maund to Chittagong will amount to 14 annas 2 pie; to Chandpur 12 annas 10 pie; and to Fakirgunj 10 annas 6 pie; therefore if Mr. Ward's assumption be correct the through freight *viâ* Fakirgunj to Calcutta would be 2 annas 4 pie less than *viâ* Chandpur, and the only set-off the latter route would have would be the saving in time. Mr. Ward shows how he has arrrived at this assumption, for he writes thus: "It must be borne in mind that no presumption can be drawn from the fact of Chandpur being nearer Calcutta than Fakirgunj that steamer freights from the former place will necessarily be cheaper: we know from experience that the river companies do not regulate their freights according to the distance travelled."

Let us look at this argument in the light of the two chief staples which the steamers carry; tea the chief article of export, and rice that of import. Of the former about 70 per cent. is produced in Sibsagar and Lakhimpur, the two districts which lie at the extreme limit of steamer navigation, and the amount produced in the lower districts of Kamrup and Goalpara is so insignificant that it may be absolutely neglected; the steamer companies may then well fix an all round rate for tea: again rice is imported to feed the garden coolies, and it is these same two districts that take the great bulk of it: in the lower districts, including Nowgong and Durrang, rice is produced in sufficient quantities on the spot to meet local wants generally, and the quantity imported into them is small, so here again the companies can afford to simplify matters by fixing an all round rate. The fact that steamer companies charge the same rate for tea carried through to Calcutta as to Goalundo does not affect the question, for no tea is now transhipped into train at Goalundo for reasons which Mr. Phillips has given in his note appended to my report of 1884. Now there must be some limit to this argument of equality of steamer freight, otherwise it might be extended until the distance became a vanishing quantity, which would be manifestly absurd. Chandpur lies roughly about one-third of the distance from Calcutta that Dibrugurh does, and half the distance of Fakirgunj, and there the Brahmaputra steamers come within a circle where competition with other steamer companies and with native boats becomes very keen : whereas above Serajgunj two companies have the river to themselves and can compete on the most favourable terms with native boats, which with difficulty contend against the strong current of the Brahmaputra, while the boatmen are subjected to hardships and risks from which they have comparative immunity on other streams: boat carriage is therefore relatively high to what it is in other parts. The appended trade report shews the respective weights of the main staples both of import and export, which fall to steamer and boat on the Brahmaputra. Taking values during the year ending 31st March 1885, steamers carried 87 per cent. of the total trade on the Brahmaputra, whereas on the Surma they carried only 57 per cent., and if we take weights of the chief commodities, instead of values of the total trade, for the same year, we shall find the proportions respectively about 64 per cent. and 6 per cent.; the percentage here for the Brahmaputra being taken from the appended sheet, and for the Surma being derived from information contained in page 17 of the report on the river-borne trade of the Province of Assam, in which the chief articles of import and export are shewn. Cocoanuts, oranges and bamboos alone have been excluded from among the articles given, as no information is present by which their weights can be deduced; but as they have been entirely carried by boat, their introduction would go to reduce the percentage of steamer traffic even below 6 per cent. These facts clearly demonstrate the different characteristics of the two rivers, and they shew how much keener would be the competition the steamers would meet at Chandpur, and that the companies would not have it in their power to keep up freights in the same manner that they could at Fakirgunj; it must also be remembered that it would not take nearly the same capital to establish steam competition between Chandpur and Calcutta that would be required between Fakirgunj and Calcutta. It is not very apparent what is to induce the two steamer companies to reduce freights from Fakirgunj, but the remote fear of fresh competition, and the experience of the Flotilla Company is not hopeful. Mr. Ward has assumed that they would be ready to reduce the freight for tea from the present rates of Rs. 2 or 1 rupee 8 annas, to 1 rupee 8 annas or 1 rupee; it may be so, but whatever the rate the fact remains that as the railways cannot be expected materially to touch the trade of the north bank of the Brahmaputra, steamers will continue to ply above Fakirgunj, and they will probably be glad to fill up with tea for a slight increase on the freight charged from Fakirgunj, in which case even the gardens most favourably situated with regard to the Railway might decline to make use of it, for to the slightly lesser cost in the through charges must be added one extra transhipment.

Mr. Ward's figures for carriage of tea not those which I placed before planters.

38. Mr. Ward then, having assumed that the rate for carriage of tea *viâ* Fakirgunj would be 3 annas less than *viâ* Chandpur, says "it is difficult to understand how with these figures before them the planters of Upper Assam could prefer the Chandpur route" and "still more difficult is it to understand Mr. Phillips's statement that the planter will gain little by carrying his tea to Fakirgunj by rail, and shipping it there." In the first place Mr. Ward's *figures* were certainly *not* those which I put before any planter, nor do I know on what grounds it is assumed that they were: on the contrary, my calculation was just the reverse of the above. In the report of 1883 on the survey between Kumilla and Silchar I stated that steamer freight on tea between Cachar and Calcutta was 1 rupee per maund and further that from Chandpur, only about half the distance, it should not exceed 10 annas, and in comparing the two routes in this respect the figures I made use of were the following:—

		Rs.	a.	p.
1. Railway freight to Fakirgunj	. . . .	0	10	0
Steamer freight in Calcutta	. . . .	1	0	0
	Total .	1	10	0
2. Railway freight to Chandpur	. . . .	0	13	0
Steamer freight to Calcutta	. . . .	0	10	0
	Total .	1	7	0

and I laid particular stress on the saving in time the latter route would effect. The planter prefers the Chandpur route because he believes it will be more expeditious and cheaper, and that it will give him the option of diverting his tea to Chittagong and shipping it here. I have met planters in Upper Assam, ignorant of the question at issue and of the position of Chandpur, who have begun by saying that a railway along the valley was what was wanted, chiefly to bring cheap labour into the country, but I have not met a single one among these who after the scheme had been explained and comprehended did not end by giving his assent to my views.

Question of competition.

39. Mr. Ward considers that competition will be less keen between the steamers and the railway if his plan of a railway to Fakirgunj is adopted; but will not competition accelerate the development of the province? and Mr. Ward has doubtless this as strongly at heart as any one.

Facilities which the two schemes offer for immigration.

40. Mr. Ward finally deprecates the merits of the question being determined from the planter's point of view only, and expresses his strong conviction "that the Assam Valley will never emerge from its present state of wilderness and isolation until a railway runs through it from one end to the other." I am very strongly of opinion that the scheme proposed will effect this desirable consummation much more rapidly than Mr. Ward's scheme would do. This emergence is, I presume, to be effected chiefly by the increased facilities for immigration which railways will afford. The bulk of the immigrants come at present from Southern Bengal; now the Chandpur line will serve all immigrants coming from Southern and Eastern Bengal to the districts of Nowgong, Sibsagar and Lakhimpur, better than the Fakirgunj line would do. Figures previously given shew that the point of equal distance from Calcutta lies some distance west of Lumding, and the fact that, whereas by the Chandpur route there will only be one river break, by the Fakirgunj at the best there must be two, will in practice tend to move this point further west. As regards immigration to the upper half of Assam it is the districts of Northern Bengal only that the extension of the railway from Gauhati to Fakirgunj will serve somewhat better than the projected scheme will do, and the extent of this will be to save immigrants at the utmost one night on board a river steamer; on the downward journey between Gauhati and Dhubri the advantage is altogether in favour of the steamers, the time which they take being only 10 hours against 18 to 20 hours taken on the upward journey. This difference further illustrates my previous remarks regarding the Brahmaputra and the river about Chandpur, inasmuch as between Goalundo and Chandpur the difference of time in the up and down stream journeys is only half an hour or 7 hours against 6½. It is the planter and those dependent upon him who contribute in a measure far beyond the proportion due to their numbers to the trade of the Brahmaputra Valley; the former is not merely interested in the cheap and expeditious export of his tea, but also in the cheap import of rice and other commodities to feed his coolies, and of tools and machinery to work his garden, and it is he also who has been chiefly instrumental in introducing population into the country; I think therefore he has strong claims to be heard.

Concluding remarks.

41. Mr. Ward then in my opinion very much over-estimates the benefits to be derived in this respect from his extension: except as regards the country between Gauhati and Fakirgunj, I doubt very much if the want of his extension would have the slightest appreciable effect. I do not mean to argue that the extension is not in the least desirable; what I contend is that the connection across the North Cachar Hills is of infinitely greater importance, and I would go further and say that this connection is of greater importance than the branch from Lumding to Gauhati: however I should be sorry to see it struck out of the scheme, as it will much improve the means of communication between Upper and Lower Assam and give all that for some time at least will be required in the direction of Northern Bengal. Mr. Ward, however, evidently fears such a contingency, but I trust that this fear will be proved to be groundless by the acceptance of the scheme, intact, as it stands. This branch to Gauhati, if made first, will considerably facilitate the construction of the northern section of the connection. In conclusion I would venture to suggest that this scheme is of greater importance than the connection of Kaunia with Dhurla and that it should first be put in hand. I have only seen two reliable estimates for the Kaunia-Dhubri line, 54 or 55 miles long, and they amount without indirect charges respectively to Rs. 1,22,26,473 and Rs. 1,95,64,708, either amount nearly sufficient to establish the connection between Badarpur and Lumding.

Correspondence with Mr. Phillips attached.

42. I append copies of correspondence which has lately passed between Mr. Phillips and myself. It will be seen that Mr. Phillips maintains his former position that a line to Fakirgunj will very slightly benefit planters; and Mr. Buckingham of Amgoori has endorsed and countersigned his letter. I shall forward the further expressions of opinion which Mr. Phillips has promised to collect when they reach me.

Information regarding steamer freights.

43. Since writing the above I have received from the Manager, Eastern Bengal State Railway, the rates of freight for seven of the chief articles of traffic between Calcutta and Cachar and Calcutta and Naraingunj; the freights by steamer direct are, for six of the articles, in the two cases in the proportion of about sixteen to seven, and for the remaining article, a little less : no tea is shipped at Naraingunj, but at the same ratio steamers must be prepared to carry tea from Chandpur to Calcutta for about 7 annas a maund and my rate of ten annas may be accepted as an outside one.

Enclosure No. 8 to P. W. D. Resolution No. 868 R. C. of 1887.

Abstract estimates of the Bengal-Assam Railway.

CHITTAGONG TO MAKUM JUNCTION.

Miles 582·413 or 575·903.

Items.	Total.	Total of Main Heads.	Rate per mile.
	Rs.	Rs.	Rs.
I.—Preliminary Expenses	7,85,649	7,85,649	1,349
II.—Land and Compensation	8,19,477	8,19,477	1,407
III.—Construction of Line—			
(*a*) Earthwork	1,09,24,195	...	18,757
(*b*) Minor Bridges	28,03,892	...	4,814
(*c*) Major "	79,76,348	...	13,695
(*d*) Level-Crossings	1,86,773	...	321
(*e*) Fencing	5,83,409	2,24,64,617	1,002
IV.—Ballast and Permanent Way—			
(*a*) Ballast	24,45,236	...	4,198
(*b*) Permanent Way	97,69,476	1,22,14,712	16,774
V.—Stations and Buildings—			
(*a*) Stations and Offices	18,12,794	...	3,113
(*b*) Workshops and Store Buildings	11,30,800	...	1,942
(*c*) Staff Quarters	15,39,702	...	2,644
(*d*) Station Machinery	11,73,474	56,56,770	2,015
VI.—Plant	12,58,954	12,58,954	2,162
VII.—Station Ferries—			
VIII.—Rolling Stock	45,84,141	45,84,141	7,871
IX.—Establishment	34,01,820	34,01,820	5,841
Total	5,11,96,140	5,11,96,140	87,903
Indirect Charges	8,68,548	8,68,548	1,491
GRAND TOTAL	5,20,64,688	5,20,64,688	89,395
Deduct for alternative line in North Cachar Hills which effects reduction of 6·51 miles	34,05,624	...	...
Grand Total of Alternative Line	4,86,59,064	...	84,492

Abstract estimates of the Bengal-Assam Railway—continued.

CHITTAGONG TO MAKUM JUNCTION.

Miles 582·413 or 575·903.

	Section.	Miles.	Total of Estimates.	Rate per mile.	REMARKS.
			Rs.	Rs.	
	Chittagong to Kumilla	96·665	85,46,325	88,412	Estimates of 1883.
	Kumilla to Silchar, 1st Division	60·420	42,47,451	70,299	
	Ditto 2nd „	46·800	38,85,319	83,020	
	Ditto Portion 3rd „	49·740	37,43,353	75,258	
Connection across North Cachar Hills.	Badarpur into Jatinga	19·569	26,11,929	1,33,473	Revised estimate of 1886.
	Jatinga to 6 miles below head.	19·250	52,61,491	2,73,324	Estimate of 1886.
	Jatinga 6 miles at head	6·000	12,33,718	2,05,619	Ditto 1885.
	Jatinga saddle to Mahur-saddle.	18·888	24,23,704	1,28,320	Ditto 1886.
	Mahur saddle to Mahur-Mupa saddle.	17·830	20,35,554	1,14,164	Ditto 1886.
	Mahur-Mupa saddle to Langting.	12·198	17,50,365	1,43,496	Ditto 1884.
	Langting to Lumding	21·830	19,31,923	88,498	Ditto 1885.
	Lumding to Kamarband Ali	96·643	67,01,270	69,340	Ditto 1885.
	Kamarband Ali to Nasira	50·200	32,15,505	64,054	Ditto 1885.
	Nasira to right bank Disang	16·100	13,30,123	82,619	Ditto 1885.
	Along right bank of Disang	24·940	11,79,787	47,305	Ditto 1886.
	Disang to Makum Junction	25·340	19,66,871	77,619	Ditto 1885.
	TOTAL	582·413	5,20,64,688	89,395	
	Deduction for alternative Line in North Cachar Hills which effects reduction of 6·51 miles—*vide* Report	6·510	34,05,624	...	
	TOTAL OF ALTERNATIVE	575·903	4,86,59,064	84,492	

Abstract estimates of the Bengal-Assam Railway—continued.

LAKSHAM TO CHANDPUR.

Miles 31·895.

Items.	Total.	Total of Main Heads.	Rate per mile.
	Rs.	Rs.	Rs.
I.—Preliminary Expenses	17,158	17,158	536
II.—Land and Compensation	95,685	95,685	3,000
III.—Construction of Line—			
(*a*) Earthwork	2,21,190	...	6,935
(*b*) Minor Bridges	1,08,443	...	3,400
(*c*) Major ,,	1,23,472	...	3,871
(*d*) Level-Crossings	16,983	...	533
(*e*) Fencing	45,437	5,15,525	1,425
IV.—Ballast and Permanent Way—			
(*a*) Ballast	1,44,123	...	4,519
(*b*) Permanent Way	6,26,440	7,70,563	19,640
V.—Stations and Buildings—			
(*a*) Stations and Offices	1,42,185	...	4,458
(*b*) Workshops and Store Buildings	94,028	...	2,948
(*c*) Staff Quarters	83,597	...	2,621
(*d*) Station Machinery	1,08,416	4,28,226	3,398
VI.—Plant	84,618	84,618	2,649
VII.—Steam Ferries	2,00,000	2,00,000	6,276
VIII.—Rolling Stock	2,87,055	2,87,055	9,000
IX.—Establishment	1,82,665	1,82,665	5,727
TOTAL	25,81,495	25,81,495	80,937
Indirect Charges	99,982	99,982	3,135
GRAND TOTAL	26,81,477	26,81,477	84,072

Abstract estimates of the Bengal-Assam Railway—continued.

BADARPUR TO SILCHAR.

Miles 17·842.

Items.	Total.	Total of Main Heads.	Rate per mile.
	Rs.	Rs.	Rs.
I.—Preliminary Expenses	17,842	17,842	1,000
II.—Land and Compensation	61,800	61,800	3,464
III.—Construction of line—			
(*a*) Earthwork	2,86,694	...	16,068
(*b*) Minor Bridges	1,32,303	...	7,415
(*c*) Major „	3,39,500	...	19,028
(*d*) Level-Crossings	8,143	...	456
(*e*) Fencing	37,468	8,04,108	2,100
IV.—Ballast and Permenent Way—			
(*a*) Ballast	50,582	...	2,835
(*b*) Permanent Way	3,47,772	3,98,354	19,492
V.—Stations and Buildings—			
(*a*) Stations and Offices	93,891	...	5,262
(*b*) Workshops and Store Buildings	21,410	...	1,200
(*c*) Staff Quarters	44,605	...	2,500
(*d*) Station Machinery	35,684	1,95,590	2,000
VI.—Plant	39,252	39,252	2,200
VII.—Steam Ferries	...	...	...
VIII.—Rolling Stock	1,60,578	1,60,578	9,000
IX.—Establishment	1,16,917	1,16,917	6,553
TOTAL	17,94,441	17,94,441	1,00,574
Indirect Charges	89,722	89,722	5,029
GRAND TOTAL	18,84,163	18,84,163	1,05,603

Abstract estimates of the Bengal-Assam Railway—concluded.

LUMDING TO GAUHATI.

Miles 110·503.

Items.	Total.	Total of Main Head.	Rate per mile.
	Rs.	Rs.	Rs.
I.—Preliminary Expenses . . .	1,38,861	1,38,861	1,257
II.—Land and Compensation . .	98,505	98,505	891
III.—Construction of Line—			
(*a*) Earthwork	18,04,492	...	16,330
(*b*) Minor Bridges . . .	2,05,075	...	1,856
(*c*) Major „	14,15,301	...	12,808
(*d*) Level-Crossings . . .	31,770	...	287
(*e*) Fencing	30,649	34,87,287	277
IV.—Ballast and Permanent Way—			
(*a*) Ballast	4,70,476	...	4,258
(*b*) Permanent Way . . .	17,95,090	22,65,566	16,245
V.—Stations and Buildings—			
(*a*) Stations and Offices . . .	1,65,732	...	1,500
(*b*) Workshops and Store Buildings .	2,21,006	...	2,000
(*c*) Staff Quarters	2,76,258	...	2,500
(*d*) Station Machinery . . .	2,21,006	8,84,002	2,000
VI.—Plant	2,21,006	2,21,006	2,000
VII.—Steam Ferries	...	...	...
VIII.—Rolling Stock	7,73,521	7,73,521	7,000
IX.—Establishment	5,30,014	5,30,014	4,796
GRAND TOTAL .	83,98,762	83,98,762	76,005

Enclosure No. 9 to P. W. D. Resolution No. 868 R. C. of 1887.

Statement of Imports and Exports of the Assam Valley.

EXPORTS.

Articles.	QUANTITIES.															Remarks.
	1881-82.			1882-83.			1883-84.			1884-85.			1885-86.			
	By Boat. Maunds.	By Steamer. Maunds.	Total. Maunds.	By Boat. Maunds.	By Steamer. Maunds.	Total. Maunds.	By Boat. Maunds.	By Steamer. Maunds.	Total. Maunds.	By Boat. Maunds.	By Steamer. Maunds.	Total. Maunds.	By Boat. Maunds.	By Steamer. Maunds.	Total. Maunds.	
Rubber . . .	...	8,279	8,279	...	8,663	8,663	5	9,460	9,465	...	7,320	7,320	...	6,489	6,489	
Jute	66,310	45,311	1,11,621	63,520	76,444	1,39,964	45,649	38,940	84,589	39,481	38,975	78,456	66,401	96,784	1,63,185	
Lac	860	23,817	24,677	2,202	14,010	16,212	3,730	27,343	31,073	2,582	14,427	17,009	2,796	27,119	29,915	
Mustard, rape and til .	4,53,194	2,41,804	6,94,998	3,92,613	75,731	4,68,374	3,08,529	1,00,773	4,09,302	3,46,367	3,97,746	7,44,113	3,25,831	4,62,363	7,88,194	
Silk	...	648	648	...	614	614	24	532	556	2	726	728	16	242	258	
Tea-seed . . .	...	2,88,754	2,88,754	6	3,48,472	3,48,478	45	3,37,672	3,37,717	...	3,65,443	3,65,443	...	4,28,021	4,28,021	
Cotton, raw . .	...	818	818	...	6,377	6,377	...	6,693	6,693	...	10,650	10,650	...	4,022	4,022	
Rice, unhusked . .	14,587	724	15,311	11,244	2,151	13,395	16,174	647	16,821	21,682	3,232	24,914	28,258	9,091	37,349	
Munjit or Madder .	2,408	2	2,410	3,603	...	3,603	64,787	...	64,787	1,60,557	...	1,60,557	47,013	5	47,018	
	...	56	56	...	488	488	...	294	294	...	9	9	...	151	151	
TOTAL .	5,37,359	6,10,213	11,47,572	4,73,218	5,32,950	10,06,168	4,38,943	5,22,354	9,61,297	5,70,671	8,38,528	14,09,199	4,70,315	10,34,287	15,04,602	
	Steamers took 53 per cent. of whole.			Steamers took 53 per cent. of whole.			Steamers took 54 per cent. of whole.			Steamers took 59½ per cent. of whole.			Steamers took 69 per cent. of whole.			

Statement of Imports and Exports of the Assam Valley—continued.

IMPORTS.

ARTICLES.	QUANTITIES.															REMARKS.
	1881-82.			1882-83.			1883-84.			1884-85.			1885-86.			
	By Boat. Maunds	By Steamer. Maunds.	Total. Maunds.	By Boat. Maunds.	By Steamer. Maunds.	Total, Maunds.	By Boat. Maunds.	By Steamer. Maunds.	Total. Maunds.	By Boat. Maunds.	By Steamer. Maunds.	Total. Maunds.	By Boat. Maunds.	By Steamer. Maunds.	Total. Maunds.	
Cotton twist, European	...	6,413	6,413	76	5,704	5,780	271	4,835	5,106	3,039	9,435	12,474	1,577	8,086	9,663	
Cotton piece goods, European.	...	20,512	20,512	59	20,228	20,287	60	15,864	15,924	62	21,832	21,894	104	34,868	34,972	
Grain and Pulse . .	15,655	94,584	1,10,239	40,259	1,20,969	1,61,228	53,005	1,10,446	1,63,451	57 197	1,01,421	1,58,618	56,498	1,94,517	2,51,015	
Rice	67,156	3,76,688	4,43,844	77,771	4,04,906	4,82,677	71,051	3,41,908	4,12,959	39,566	3,40,111	3,79,677	77,695	3,83,171	4,60,866	
Brass and Copper .	168	6,141	6,309	1,029	5,770	6,799	990	5,719	6,709	950	7,671	8,621	1,136	12,053	13,189	
Iron	716	21,325	22,041	3,613	55,705	59,318	3,740	75,889	79,629	8,336	50,973	59,309	8,538	61,778	70,316	
Other metals . .	13	22,330	22,343	240	25,274	25,514	452	27,786	28,238	445	29,919	30,364	378	36,589	36,967	
Oils, Mineral, other .	32,349	8,149	40,498	4,626	3,086	7,712	10,279	1,172	11,451	20,428	4,449	24,877	10,781	10,477	21,258	
				40,011	8,492	48,503	37,100	9,060	46,160	39,275	8,521	47,796	41,157	13,888	55,045	
Ghi	165	5,064	5,229	421	5,573	5,994	570	6,143	6,713	659	7,356	8,015	723	6,987	7,710	
Provisions (other kinds)	2,400	9,936	12,336	...	15,195	15,195	898	24,266	25,164	...	30,378	30,378	68	47,279	47,347	
Salt	1,37,159	1,04,373	2,41,532	82,882	1,29,600	2,12,482	93,485	1,28,603	2,22,088	1,00,363	1,14,759	2,15,122	1,03,775	1,37,899	2,41,674	
Sugar . . .	27,631	12,782	40,413	31,528	14,426	45,954	31,327	15,982	47,309	36,407	20,427	56,834	68,422	22,413	90,835	
Tobacco . . .	19,360	1,269	20,629	31,484	1,161	32,645	20,144	2,291	22,435	22,671	3,009	25,680	32,282	5,401	37,683	
Opium . . .	...	1,674	1,674	...	1,789	1,789	...	1,425	1,425	...	2,166	2,166	...	1,291	1,291	
Total . .	3,02,772	6,91,240	9,94,012	3,13 999	8,17,878	11,31,877	3,23,372	7,71,389	10,94,761	3,29,398	7,52,427	10,81,825	4,03,134	9,76,697	13,79,831	
	Steamers took 70 per cent. of whole.			Steamers took 72 per cent. of whole.			Steamers took 70 per cent. of whole.			Steamers took 70 per cent. of whole.			Steamers took 71 per cent. of whole.			

Enclosure No. 10 to P. W. D. Resolution No. 868 R. C. of 1887.

Note by Mr. G. L. Molesworth, dated 16th October 1886.

The detailed plans and sections of the Bengal-Assam State Railway—as now submitted by Mr. Buyers, the Engineer-in-Chief—fulfil, in the most satisfactory manner, the anticipations formed by Mr. Buyers from his preliminary investigations, as confirmed by my personal reconnaissance and barometer observations, described in my note of March 27th, 1884.

These plans and sections shew that a practical Locomotive line may be constructed, at a reasonable cost, through the mountain range that has hitherto separated Upper Assam, or the valley of the Burhampootra, from Lower Assam or the plains of Cachar and Sylhet, and from Eastern Bengal; and prove that it is quite feasible to develop the rich districts of Upper Assam by railway communication, which will enable goods to be shipped at the port of Chittagong without break of continuity.

The ruling gradient of the line through the mountain range, as submitted, is 1 in 70, with curves of a minimum radius of 573 feet; but I am of opinion that it will be desirable to adopt Mr. Buyers' suggestion for the introduction of an exceptional gradient of about 1 in 45 in the Jatinga Valley, and possibly in the vicinity of the Mahur Saddle.

Mr. Buyers estimates that the saving to be effected in the Jatinga Valley alone by the adoption of this exceptional grade, will be about 28¾ lakhs of rupees; and after a careful examination of the plans and sections, I have arrived at the conclusion that the exceptional grade may be adopted with advantage.

This grade may be easily worked by additional engines from the changing station on the "Haflong Spur" without diminishing the load due to the otherwise ruling gradient of 1 in 70 on the remainder of the Ghât Section.

I am also of opinion that the minimum radius of curves may be reduced to 400 feet, but only when it will be productive of considerable saving, and that, if this minimum radius be adopted, there will be a large diminution in the earthworks and bridges over the ravines of the Ghât Section.

It will be desirable, however, in this case, that the whole of the rolling stock of the Bengal-Assam Railway should be constructed on the bogie principle, and as this system is entirely isolated by the Burhampootra and Megna Rivers, the rolling stock of other railway systems of India will never run over these curves, which, however, would not render the use of such stock prohibitory.

The Ghât Section of the Railway will, if the exceptional grade of 1 in 45 or thereabouts be adopted, be about 85 miles in length from an elevation of about 400 feet above the sea, at the southern base of the range, to the same level at the northern base of the range.

The route will pass over the following water-sheds :—

	Miles from Chittagong.	Elevation above sea level.
Jatinga	295	1,863
Mahur	314	1,836
Mupur	329	881
Dijako	335	793
Langladisa	350	812

An examination of the detailed plans and sections of the alternative projects for approaching the Jatinga Valley confirm the opinion I expressed in my notes of 24th October 1883 and March 27th, 1884, to the effect that the route *viâ* Budapur is preferable to that *viâ* Telyntila.

The work on the former alternative being fairly easy except where a short tunnel is necessary to enter the Jatinga Valley. But, as borings at the Budapur Fort crossing proves its unsuitability, the site shown on the plans is about 7 chains lower down the stream from the Fort.

Taking, however, into consideration the fact that the constriction of the river at the Fort is liable to hold back the flood waters of the Barah River, to some extent, I would advise the adoption of a site for the bridge still lower down, so as to keep away from the rush of water that must necessarily ensue from the contraction of the river in times of flood.

After crossing the Barah River the formation level of the line keeps some close to the level of the flood-spill of the Barah, but as Mr. Buyers has explained that this height of flood has not been attained for 50 years; and that the spill water is, from its character, almost dead water, the level of formation adopted may be allowed.

The work in the Jatinga Valley is exceedingly heavy; in some cases averaging in cost about 2¾ lakhs of rupees per mile, but the introduction of the exceptional grade of 1 in 45 or thereabouts will materially diminish the work.

From the top of the Jatinga Valley to the Saddle at the head of the Langladisa Valley the work will be lighter, but still very heavy, especially in the vicinity of the Mahur Saddle, and between the Mupur and Dijako Saddles; but after the Langladisa Saddle has been crossed, the descent into the plains along the Langladisa Valley is easy, and comparatively inexpensive.

From the northern base of the hills to Dimapur the atlas sheets are misleading, representing an alluvial plain in which the streams are by no means correctly shown, but this portion is very much cut up by low hills covered with dense jungle, which has rendered the alignment a matter of considerable difficulty.

Beyond Dimapur the route I suggested in my note of the 28th of October 1885,—crossing the Dhansiri a little to the north of Dimapur, and keeping in the delta between the Dhansiri and the Daiang Rivers,—has been surveyed with the most satisfactory results, affording an extremely light and inexpensive, with scarcely any cross, drainage. After the crossing of the Daiang River the country is very flat, the principal work being caused by the crossing of the drainage of the Naga Hills, and the necessity for keeping above the flood level of the country, but the line has been judiciously selected and is far preferable to one taken through the low land in the immediate vicinity of the river Burhampootra. For 25 miles a very inexpensive line has been obtained by crossing to the right bank of the Disang River and keeping along it; as this river intercepts the drainage from the Naga Hills, on the left bank, whilst nearly all the drainage on the right bank falls towards the Burhampootra, I am of opinion that the Bengal-Assam line should be carried on to Makum Junction rather than to Dibrugurh.

With reference to the Gauhati branch I have little to add to my former note of the 27th of March 1884, except that the flood level shewn on the detailed sections renders it necessary to raise the embankments to a higher level than I had anticipated at the time of my reconnaissance; and consequently increases the cost of the branch.

The only part of this branch which I considered doubtful in my reconnaissance was the portion between Gauhati and the Digru River, and it has been found necessary to adopt the more circuitous route of the two alternatives which I indicated in dotted red lines marked A A on the map that accompanied my previous note, and this has given a fairly easy line for a railway.

The cost of the Bengal-Assam State Railway, as now estimated from the plans and sections, averages as follows per mile of railway :—

	Miles.	Per mile. R
Chittagong to Budapur	253¾	80,522
Budapur to Lumding	115½	1,49,255
Lumding to Makum	213¼	67,505
Gauhati Branch	110½	76,065

These estimates must, to a certain extent, be considered approximate; for the country, in the Ghât Section especially, is sparsely populated and unhealthy, and labour and supplies will have to be imported, so that it is difficult to predict how the rates may be influenced by an unhealthy season or by the difficulty of obtaining supplies or labour, and so soon as it may be decided to construct the railway, no time should be lost in constructing those portions of the line by which the permanent way can be pushed forward rapidly to the foot of the hills so as to facilitate the construction of the Ghât Section by railway carriage. On the other hand, the plans and sections must be considered as only approximately representing the work to be executed.

In so difficult a country a close and intelligent revision of even the most carefully prepared plans and sections is certain to result in reductions by improved alignment; and by the adoption of the exceptional grade of 1 in 45 and a minimum radius of 400 feet for the curves will be followed by a considerable diminution of work.

I would strongly recommend that Mr. Buyers should at once be instructed to revise the plans and sections in accordance with the above remarks, and that the survey of the line for an exceptional gradient of 1 in 45 in the Jatinga Valley should be undertaken during the present cold season.

Mr. Buyers, to whom I have spoken on this subject, estimates that the cost of such operations, including the necessary field work and jungle clearing, will be about Rs. 20,000, exclusive of the salaries of the permanent members of the engineering staff.

Pending the results of this revision I think that the Government may accept provisionally the estimated cost of the line from Chittagong to Makum Junction at an average of Rs. 90,000 per mile, and that of the Gauhati branch at Rs. 78,000 per mile.

With reference to the general question I may confine the opinions expressed in the last five paragraphs of my note of the 27th of March 1884.

I may add that the close approximation of the detailed results to those of the preliminary reports reflects great credit on the engineering qualifications of Mr. Buyers.

Enclosure No. 11 to P. W. D. Resolution No. 868 R. C. of 1887.

Extract from note by Colonel F. S. Stanton, Director General of Railways, dated 18th October 1886.

Mr. Buyers has evidently carried out the difficult work entrusted to him with great care and excellent judgment, and I think it would be a great pity if he cannot be allowed to complete the further survey required in the Jatinga Valley to ascertain the result on the estimate of adopting an exceptional gradient of 1—45 and curves of 400 feet radius, as there is an anticipation of reducing the estimate by 28 lakhs of rupees if this course is adopted.

In regard to the great question of route to Assam *viâ* the Cachar Hills or *viâ* the Valley of the Brahmaputra, it certainly seems to me that the former possesses enormous advantages over the latter, as a means of developing this backward region.

Chittagong should obviously be the port for Assam and Cachar, and this railway by supplying the one great want, good coal for sea-going steamers, would enable shipping business to be dealt with there at a cost with which Calcutta with its dangerous river approach cannot compete.

* * * * *

I would further beg to suggest that the thanks of the Government of India be given to Mr. Buyers and his staff for the care and ability with which the project has been worked out; and should the further work recommended in the Jatinga Valley be authorized, Mr. Buyers might be asked to submit an estimate of the cost of the survey required before he leaves Simla.

Enclosure No. 12 to P. W. D. Resolution No. 868 R. C. of 1887.

No. 856 R. C., dated 27th October 1886.

From—The Government of India, P. W. Dept.,
To—The Chief Commissioner of Assam.

I am directed to acknowledge the receipt of your letter No. 3176, dated the 28th September 1886, forwarding the Bengal-Assam Railway's estimates with reports dealing with last season's survey operations as well as the entire work done by Mr. Buyers' survey party, and, in reply, to request that the thanks of the Government of India may be conveyed to Mr. Buyers and his staff for the care and ability with which the project has been prepared. A formal Resolution on the subject will be prepared and published with Mr. Buyers' report in the *Gazette of India*, but meanwhile some further orders on the subject are necessary in order that the project may be left in a complete form and ready to be taken up at any moment by any Company desiring to construct the line.

2. With reference to Mr. Buyers' remarks as to a gradient of 1 in 45 in the Jatinga Valley, the Government of India desires that the effect on the estimate of the adoption of this grade should be investigated. In this view Mr. Buyers, while in Simla, has submitted a revised estimate, a copy of which is herewith forwarded, in which he puts the cost of the further surveys necessary to determine the question at Rs. 42,150; to this estimate I am to accord the sanction of the Government of India, and to state that such further staff as Mr. Buyers needs for this work is being collected.

3. I am, however, at the same time to express a hope that the work will be completed well within this sum and also within the time of 6 months which the estimate covers. It is very desirable that the results of this investigation should be submitted to the Government of India by April next if possible.

4. This sanction has been registered as No. 1 B. A. Ry. of 1886-87.

Document accompanying.
One estimate.

Enclosure No. 13 to Public Works Department Resolution No. 868 R. C. of 1887.

No. 833 R. C., dated 20th October 1886.

From—The Government of India, Public Works Department,
To—The Secretary to the Government of Bengal, P. W. Dept.

With reference to your letter No. 4338 R., dated 14th December 1883, forwarding an estimate of cost of a railway from Chittagong to Chandpore with branch to Comillah, I am directed to inquire whether the Government of Bengal maintains, unchanged, the opinion expressed in that letter as to the estimated traffic and remunerativeness of such a line.

Documents accompanying.
Nil.

Enclosure No. 14 to Public Works Department Resolution No. 868 R. C. of 1887.

No. 463 R., dated 2nd March 1887.

From—COLONEL S. T. TREVOR, R.E., Secy. to the Govt. of Bengal, P. W. Dept.,
To—The Secretary to the Government of India, P. W. Dept.

I am directed to acknowledge the receipt of your letter No. 833 R. C., dated 20th October last, enquiring whether the Government of Bengal maintains unchanged the opinion expressed in this office letter No. 4338 R., dated 14th December 1883, as to the estimated traffic and remunerativeness of the projected railway from Chittagong to Chandpore with branch to Comillah, and, in reply, to communicate the following observations.

2. The estimate for this railway, which was forwarded to the Government of India with the letter above quoted, amounted to Rs. 1,12,27,802, or Rs. 87,335 per mile; and in submitting it, the remark was made that, though it required several minor alterations, it might be accepted as fairly correct. This estimate was made in 1883, and subsequent experience gained on other lines, which have been since constructed in Bengal, shows that it needs revision. For example, the outlay provided in it for stations and buildings is Rs. 21,97,706, and unless the line is to be built at once as the base of a future independent railway system into Assam, this amount seems excessive. It provides for the construction of warehouses, sheds, and a jetty at Chittagong, at a cost of rupees 3⅝ lakhs, which, now that a Port Trust is to be established there, will probably be provided by the Port Commissioners. It provides also for extensive workshops, offices and staff-quarters, which the experience of the Dacca line shows it to be inexpedient to build before the state of the traffic and the conditions under which the line is to be managed make it absolutely necessary to build them. It provides, moreover, for a ferry service at a cost of rupees 2 lakhs. If the line is to have an independent ferry service, this sum would be quite insufficient; but it will probably be found that a suitable expansion of the ferry service of the Eastern Bengal Railway will be sufficient for all practical purposes. Under some misapprehension of the rules on the subject, the provision for indirect charges is a *minus* quantity, while a sum of Rs. 4,80,000 is included in the estimate for interest on outlay during construction, which is unusual. Finally, there has been a considerable fall in the market price of rails and other material since the estimate was made. It will certainly be necessary, therefore, to revise the estimate before the construction of the line is undertaken, and it seems probable that the result of the revision will be that it will be found to be susceptible of reduction.

3. Turning now to the estimates of traffic, I am to remark that those which were forwarded to the Government of India with this office letter No. 200 T. R., dated 23rd June 1882, were prepared with the greatest possible care and attention from the trade returns of the province, and they showed that a gross revenue of over 18 lakhs of rupees might be expected from the Chittagong Railway, and a net return of 8 per cent. on the capital outlay of 112 lakhs. Experience has shown, however, that little reliance can be placed on any estimates of traffic, however carefully they may be prepared, as there are many influences at work in regulating the course of trade which cannot be foreseen. On now being asked, therefore, whether the Government of Bengal maintains unchanged the opinion expressed more than three years ago as to the estimated traffic and remunerativeness of the line, Sir Rivers Thompson is disposed to give a less confident answer as to the particular rate of interest which may be expected from the capital to be employed on the undertaking. But he maintains unchanged the opinion that this railway is second to none in Bengal in importance, and that there is every prospect of its proving to be very remunerative. The extraordinary development of the trade of the Port of Chittagong during the last ten years, as shown by the figures given on the margin, appears to him to afford ample ground for this opinion, especially when it is remembered that this development has taken place in spite of many adverse circumstances as regards the means of communication between the Port and the interior as well as between the Port and the sea. The railway will not only serve this trade, but also a large inland trade from the districts through which it passes. These districts are densely populated, and the people are in very easy circumstances, so there is every prospect of a large traffic in passengers as well as goods. The districts, moreover, are at present so badly off for communication that it is well-known that year after year a large part of the crops is left uncut for want of means of conveying the produce to any market.

	Imports. Rs.	Exports. Rs.	Total. Rs.
1876-77 .	16,20,197	24,48,232	40,68,429
1877-78 .	15,42,537	40,07,807	55,50,344
1878-79 .	20,94,815	54,90,639	75,85,454
1879-80 .	56,68,458	67,68,714	1,24,37,172
1880-81 .	69,89,499	64,90,899	1,34,80,398
1881-82 .	79,89,366	95,49,497	1,75,38,863
1882-83 .	1,04,09,715	1,22,56,997	2,26,66,712
1883-84 .	1,11,27,673	1,28,79,055	2,40,06,728
1884-85 .	1,10,63,570	1,01,95,328	2,12,58,898
1885-86 .	92,44,095	1,11,43,716	2,03,87,811

Enclosure No. 15 to Public Works Department Resolution No. 863 R. C. of 1887.

Supplementary Report by J. W. BUYERS, Esq., *M.I.C.E., Engineer-in-Chief, Bengal-Assam State Railway, on the Bengal-Assam Railway Survey,—dated the 18th February 1887.*

During the past cold season a party has been employed under Mr. E. J. Moore, Executive Engineer, in completing the survey of the alternative alignment at the head of the Jatinga Valley, ordered in para. 2 of Government of India letter No. 856 R.C., dated the 27th October 1886.

2. In recommending this alternative, in place of the alignment first proposed between the Kayeng river and the Jatinga saddle (*vide* paras. 16—18 of my report on the survey operations

during the seasons 1885-86 and 11 and 13 of my final report, both submitted in September 1886), I stated that it was anticipated that it would save 3·62 miles in length, and Rs. 28,74,884 in cost, and that a portion, 6½ miles long, had already been surveyed at the lower end, leaving 10·34 miles to be done, which, judging from the corresponding section of the upper trace, might cost Rs. 20,82,891, or Rs. 2,01,440 per mile.

3. The party has been engaged in filling in the survey of this latter section and has now returned to head-quarters having completed the fieldwork, but until the estimates are finished the accuracy of the above figures cannot be exactly determined. Mr. Moore, however, thinks that the cost will be somewhat under the figures I have given, probably lying somewhere between Rs. 1,80,000 and Rs. 1,90,000 per mile: if this prove to be the case, the estimate will be affected by something under two lakhs rupees, and the saving which this alternative will effect will be increased to over Rs. 30,00,000.

4. A traverse has been run direct down from the Jatinga saddle to the end of the lower section, which was carried, during the previous season, to a distance of 6½ miles above the Kayeng. By the aid of this and cross sections a line will be laid down on the plans. The cross sections have been taken so as to cover a minimum gradient of 1 in 40. I have seen the rough field plans on which two approximate lines have been laid down—one to suit a uniform gradient of 1 in 45, and the other 1 in 40. From the saddle to chain 440, that is on the upper 8·33 miles, Mr. Moore says that, so far as he can judge by the eye, there is nothing to choose between the two as regards the nature of the ground, but that the production below chain 440 from the 1 in 45 gradient leads into much heavier work than the production of the 1 in 40 grade. This is what might be expected, for the 1 in 40 gradient sooner reaches the bottom of the valley, and as long as they are both well up the hill side, there is little difference in the work.

In order to decide the question of which aligument should be adopted in preparing the plans and estimates, Mr. Moore has prepared for me rough sections on the production of both lines below chain 440; this in both cases being made with a uniform 1 in 40 gradient, as the further prolongation of the 1 in 45 grade would carry the line across the Lokashah with a viaduct which it is desirable to avoid, as stated in the paragraphs of the reports previously referred to. After examining both sections, I have instructed Mr. Moore to lay out the line on the plan for a uniform 1 in 40 grade from the saddle down to chain 526 (10 miles), where reduced level of formation would be 548 feet above mean sea-level at Chittagong; to run down from chain 526 to about chain 578 with a gradient of 1 in 70, after which there would be about 20 chains level where there is suitable ground for a station. Mr. Moore may find it necessary to make some slight modifications when the line is finally laid down on the finished plans, but I understand that these are the general ideas which also commend themselves to him. If found desirable, about 50 feet more may be taken off the Jatinga saddle; this will somewhat ease the gradients on each side, and only increase the work immediately at the saddle itself.

5. As I am leaving, Mr. Moore will submit the plans and estimates for this section, and I see no reason why he should not be able to do so by the middle of April. The advantages of this lower alternative have been detailed by me in the reports referred to, and it is not likely that he will have much to add beyond giving the correct figures, and altering the tabular statement given in para. 2 of my final report, which, as I have said above, may possibly be reduced by about 2 lakhs rupees.

6. I have gone through the hill plans with a view of determining what improvements, if any, could be made, and the results are shewn both on plans and sections in full blue lines. In doing this, I have had the following objects in view:—

(1) To improve the alignment generally, either by reduction of the number of curves or degree of curvature, without, at the same time, increasing the amount of work.

(2) To extend the length of straight between reverse curves from the minimum of 100 feet, which had been employed, to a minimum of 30 feet.

(3) To try the effects of using curves to a minimum radius of 410 feet (14°) in place of 573 feet (10°), which had been the limit employed.

The second naturally increases the amount of work, but not to any considerable extent except in one instance, *viz.*, in mile 319, where no alteration has been made, as the length of straight between the reverse curves is already 200 feet. In all the other cases, I think the changes are advisable. I have not had time to work out the results of the alterations which have been made (indeed this would be the labour of two or three months), but I think the sections shew that, with a considerably improved alignment, the work on the whole is at least not heavier.

7. In paragraph 11 of my final report of September 1886 I stated that the employment of curves of 400 feet radius, instead of 578 feet, at certain points in the upper parts of the Jatinga and Mahur valleys, was calculated to effect a reduction of R10,41,928 in the estimates; of this, R8,20,154 are the share of that portion of the line in the Jatinga Valley which, I take it for granted, will be abandoned in favour of the lower alternative; the balance of R2,21,774 represents the contribution of the Mahur Valley section, to which must be added

any economies which can be effected in the same way elsewhere. In going through the plans I have found that the places are extremely few where anything but a very trifling economy can be effected, so that I am not now prepared to recommend the adoption of such sharp curves. I think that on the stiff ascent with a gradient of 1 in 40 or 1 in 45 at the head of the Jatinga Valley, it will be worth paying a good deal for the easier 10° curves.

8. I have not been able to make any alterations in the first 5 miles of the Jatinga Valley, and also between the Mahur-Mupa watershed and the Langting river, miles 335 to 347, as there is not sufficient information on the plans in the shape of cross sections to enable me to make these with any degree of accuracy. The line on this short section of the Jatinga Valley, as also between miles 335 and 342, has been actually located, and therefore few cross sections were taken.

The alterations, except such as are due to lengthening the straight between reverse curves, are, with one exception, confined to those sections of the line the plans and estimates of which were prepared last year under some degree of pressure, as noted in paragraph 11 of my final report.

Enclosure No. 16 to P. W. D. Resolution No. 868 R.C. of 1887.

Report by Mr. E. F. Moore, Executive Engineer in charge Bengal-Assam Survey, in operations in 1886-87, revised with General Abstract Estimate.

Object of survey.

1. With the submission of the accompanying plans and estimates of the work of 1886-87, the project for the Bengal-Assam Railway is completed, and there is but little to add to the supplementary report of Mr. J. W. Buyers, late Engineer-in-Chief, forwarded with this office letter No. 1000, dated 18th February 1887. The object of the survey of 1886-87 was the completion of the alternative route up the Jatinga valley (*vide* Mr. Buyers' Report, paragraph 16, page 41 for 1885-86), by a steep grade line from the Jatinga saddle, to join Mr. Sherman's Low Leve, Line along the bottom of the Jatinga Valley surveyed during the season of 1885-86, and, as explained in paragraph 16 of Mr. Buyers' report above referred to, it appeared certain that a grade of 1 in 40 could be obtained, and possibly 1 in 45 if distance were gained. Traverses were, therefore, run and sections taken to cover both these grades.

Grading and alignment.

2. As a matter of fact, however, there has been a saving of 0·28 mile in distance, for, while the estimated mileage from Badarpur to the Jatinga saddle (*vide* paragraph 16 of the same report) is 30·20 miles, the actual mileage as now ascertained is 29·92 miles. The steep grade line joins Mr. Sherman's Low Level line at chain 61·00 on his section, thereby overlapping it by a distance of 1·16 miles. So much of Mr. Sherman's line is, therefore, cancelled. The question of gradient on the Steep Grade line was determined by Mr. J. W. Buyers before leaving Shillong (*vide* paragraph 4 of his supplementary report of 1886-87). The reasons for the adoption of the ruling gradient of 1 in 40 are there given and need not be repeated. From chain O at the Jatinga Saddle, corresponding to mile $\frac{298\cdot45}{294\cdot55}$ of the through line from Chittagong there is a continuous fall of 1 in 40 to chain 522·00, and thence a grade of 1 in 70 for 46·90 chain to chain 568·90. From chain 568·90 to 586·15 there is a level of 17·25 chains, where the only ground suitable for a station exists. From chain 592·50, corresponding with Mr. Sherman's chain 61·00, at which point this season's work ends, Mr. Sherman's grade of 1 in 70 is carried back until it meets the station level at chain 586·15. The 46·90 chains of the 1 in 70 grade on the north side of the station yard will afford a fair start for trains before reaching the steep portion. The level of the station yard is 491·00, which is at least 31 feet above the low water level of the Jatinga, a height which I consider perfectly safe from flood.

Length and cost.

3. The length in miles of the survey of 1886-87 is 11·2286 and the cost Rs. 18,25,877 or Rs. 1,62,711 per mile, against a rate of Rs. 2,01,440 per mile for the corresponding section of the upper line—a result fully justifying Mr. Buyers' arguments in favour of the lower alternative and even more favourable than I led him to expect.

Earthwork.

4. The rate of Earthwork, although high, Rs. 77,307 per mile, compares favourably with Rs. 79,420 per mile for the 19·25 miles of upper line surveyed by Mr. Sherman during the season of 1885-86 and Rs. 1,00,211 per mile of the 6·48 miles at the head of the Jatinga valley surveyed during the season of 1884-85. On the 11·22 miles there are seven tunnels of an aggregate length of 2,730 feet.

Minor bridging.

5. Although I think I have allowed ample waterway, the rate for minor bridging is but Rs. 3,042 per mile. This economy is entirely effected by raising the culverts wherever possible to the point at which the line runs from bank into cutting, allowance being made for filling in

earth on the upper side of the line to prevent the lodgment of any standing water against it. This plan has the further advantage of admitting of the easy extension of the culverts should the waterway anywhere be found insufficient.

Major bridging.

6. There are eleven major bridges, the highest and most important of which is that over the Mailongdisa, consisting of one span of 100 feet and seven spans of 40 feet each and costing Rs. 81,935, or Rs. 190 per foot run. The rate per mile for major bridging is Rs. 31,530 as against Rs. 1,12,029 of the 19·25 miles of upper line surveyed in 1885-86 and Rs. 32,266 per mile of the 6·48 miles, at the head of the Jatinga valley surveyed during the season of 1884-85. The height of the viaduct over the Mailongdisa is but 100 feet, and the difference in the rate per mile is chiefly due to the fact that the ravines on the lower line are crossed at a much less height from stream bed to formation than the upper one, and also because, as the streams approach the bottom of the valley, they run together, and become fewer in number.

Deduction from Estimate of 1885-86 due to overlap and total cost of Jatinga alternative.

7. In paragraph 2 I have stated that the line surveyed this season overlaps Mr. Sherman's Low Level Line by 1·16 miles, the cost of which, as abstracted from Mr. Sherman's estimate, is Rs. 1,34,656. This amount will be deducted from Rs. 7,94,587, the cost of the 6·48 miles run by Mr. Sherman (*vide* paragraph 16, page 4 of Report of 1885-86), and the difference of Rs. 6,59,931 added to Rs. 18,25,877, the estimate of the Steep Grade Line surveyed this season, gives Rs. 24,85,808, the cost of the whole Jatinga valley alternative from mile 24·38 from Badarpur (*vide* Report, same paragraph) to mile 40·92 from Badarpur at the Jatinga saddle. This is a rate of Rs. 1,50,290 per mile for 16·54 miles.

Possible minor alternative.

8. I may remark that while adopting the present Steep Grade Line as far as the end of the station yard, I think it would be advisable to try a line crossing the Lokashah somewhere opposite chain 80 on Mr. Sherman's section, keeping to the right bank of that river as far as the Lakamah, which would be crossed somewhat higher than at present. This would not involve a high viaduct over the Lokashah. Mr. Sherman's line at present between the Lokashah and Jatinga, for about a mile runs in high bank, the toe of which is but about 10 feet above the Jatinga low water level, a height scarcely safe from flood. Owing to the very limited time at our disposal it was not intended to carry this season's survey further than it has been taken, and the above change of alignment is but a minor alternative.

Limiting curves.

9. The limiting curves as in previous years is one of 10 degrees equivalent to a radius of 573 feet; and straight of not less than 300 feet has always been allowed between reverse curves.

Corrections in Mr. Buyers' Reports resulting from work of 1886-87.

10. There now only remains to correct those portions of Mr. Buyers' Report of 1885-86 in which the figures are affected by the work of the past season.

In paragraph 2 (i), page 9, instead of 575·903 miles, the main line becomes 575·625 miles, as shewn below :—

Total mileage, page 24 of Report	582·413
Miles by upper line table, paragraph 15, page 4	20·44
Deductions.	
Mr. Sherman's line 6·48 less 1·16 miles	5·32
Steep Grade Line of 1886-87	11·222, 16·542
Actual difference in favour of Lower alternative in Jatinga valley .	3·898
Add saving by Mahur alternative	2·890
Total saving by alternative	6·788
Total mileage of main line by alternative	575·625

Table, para 2, page 10, will be recast as follows :—

Section.	Length, Miles.	Total estimates cost.	Mean rate per mile.	Remarks.
		Rs.	Rs.	
1. Main line	575·625	4,82,67,394	83,852	When mileage is denoted by two figures, as $\frac{870}{863}$, the upper denotes through mileage on the plans, the lower, alternative alignment recommended, the exact total difference between the two being 6·788 miles.
2. Chandpur Branch . . .	31·895	26,81,477	84,072	
3. Silchar Branch . . .	17·842	18,84,163	1,05,603	
4. Gauhati Branch . . .	110·503	83,98,762	76,005	
Total .	735·865	6,12,31,796	83,211	

For comparison with the table given in paragraph 16, page 4, I insert a similar one with actual results.

Section.	Miles.	Estimated cost.	Rate per mile.	Remarks.
		Rs.	Rs.	
Miles from Badarpur 11 to 24·38 .	13·38	16,61,506	1,24,178	
Ditto ditto 24·38 .				
Ditto ditto 409·2 .	16·54	24,85,808	1,50,290	5·32 + 11·22 miles.
Total .	29·92	41,47,314		
Difference in favour of lower alternative.	3·90	32,66,554		

I attach to my estimate a revised abstract in place of that at page 24 of Mr. Buyers' Report. The alterations effected in this by the work of season 1886-87 are as given in the following table :—

Main line by subdivisions, Chittagong to Makum Junction, miles 582·413 or 575·625.

Miles 582·413 or 575·625.

SECTION.	Miles.	Total of estimate.	Rate per mile.	REMARKS.
		Rs.	Rs.	
Totals of Main Line by Sub-Division.	582·413	5,20,64,688	89,395	
Deduction for alternative line in the North Cachar Hills which effects a reduction of 6 788, *vide* Mr. Buyers' Report, page 6, paragraph 27.	6·788	37,97,294	...	Jatinga Valley . 3·898 Mahur Division . 2·89 Total . 6·788
	575·625	4,82,67,394	83,852	

11. In conclusion, I beg to bring to the notice of the Government of India the services of Mr. A. R. Lilley, Executive Engineer, and Messrs. E. I. Alexander and E. T. Faulkner, Assistant Engineers, on account of their very hard work in the field and afterwards in the office. Orders for the survey being received late in the season, field work was not commenced until December 10th, 1886, Messrs. Alexander and Faulkner arriving there a week later. Field work was closed on January 29th, 1887, while I left the Jatinga Valley on the 19th of January to take over charge from Mr. Buyers, leaving Mr. Lilley to complete the survey. The plans submitted are therefore the result of six weeks' field work only. And it is due to the subsequent exertion of these officers that the estimates have been completed at such an early date.

EDWARD J. MOORE, *M.I.C.E.*,

Executive Engineer in charge

Bengal-Assam Railway.

BENGAL-ASSAM RAILWAY.

NORTH CACHAR HILLS DIVISION.

STEEP GRADE ALTERNATIVE AT JATINGA HEAD.

Season 1886-87.

Items.	Total.	Total Main Head.	Rate per mile.	Rate per mile of Main Head.
	Rs.	Rs.	Rs.	Rs.
I.—Preliminary Expenses .	22,443	22,443	2,000	2,000
II.—Land . . .	...	...	...	...
III.—Construction of Line—				
(*a*) Earthwork . .	8,67,509	...	77,307	...
(*b*) Minor Bridging .	34,130	...	3,042	...
(*c*) Major Bridges .	3,53,821	...	31,530	...
(*d*) Level Crossings .	1,122	...	100	...
(*e*) Tracing . .	1,122	12,57,704	100	1,12,079
IV.—Ballast and Permanent-way—				
(*a*) Ballast . . .	38,176	...	3,402	...
(*b*) Permanent-way .	1,73,733	2,11,909	15,482	18,884
V.—Stations and Buildings—				
(*a*) Stations and Offices .	16,833	...	1,500	...
(*b*) Workshops . .	22,443	...	2,000	...
(*c*) Staff Quarters .	28,054	...	2,500	...
(*d*) Station Machinery .	22,443	89,773	2,000	8,000
VI.—Plant . . .	22,443	22,443	2,000	2,000
VII.—Steam Ferries . .	...	...	...	...
VIII.—Rolling Stock . .	78,541	78,551	7,000	7,000
IX.—Establishment . .	1,43,054	1,43,054	12,748	12,748
TOTAL .	18,25,877	18,25,877	1,62,711	1,62,711

EDWARD J. MOORE, *M.I.C.E.*,
Executive Engineer in charge
Bengal-Assam State Railway.

A. R. LILLEY,
Executive Engineer,
North Cachar Hills Division.

BENGAL-ASSAM RAILWAY.

ABSTRACT OF ESTIMATES OF MAIN LINE BY SUB-DIVISION CHITTAGONG TO MAKHUM JUNCTION.

Miles 582·413 or 515·625.

	Section.	Miles.	Total of Estimates.	Rate per mile.	REMARKS.
			Rs.	Rs.	
	Chittagong to Kumilla .	96·665	85,46,325	88,412	Estimates of 1883.
	Kumilla to Silchar, 1st Division	60·420	42,47,451	70,229	
	Ditto 2nd „	46·800	38,85,319	83,020	
	Ditto portion 3rd „	49·740	37,43,353	75,258	
Connection across North Cachar Hills.	Badarpur to Jatinga .	19·569	26,11,929	1,33,473	Revised Estimate of 1886.
	Jatinga to 6 miles below head.	19·250	52,61,491	2,73,324	Estimate of 1886.
	Jatinga 6 miles at head .	6·000	12,33,718	2,05,619	„ 1885.
	Jatinga Saddle to Mahur saddle.	18·888	24,23,704	1,28,320	„ 1886.
	Mahur Saddle to Mahur Mupa Saddle.	17·830	20,35,554	1,14,164	„ 1886.
	Mahur Mupa Saddle to Langting.	12·198	17,50,365	1,43,496	„ 1884.
	Langting to Lumding .	21·830	19,31,923	88,498	„ 1885.
	Lumding to Kamarbund Ali .	96·643	67,01,270	69,340	„ 1885.
	Kamarbund Ali to Nazira .	50·200	32,15,505	64,054	„ 1885.
	Nazira to right bank Disang .	16·100	13,30,123	82,619	„ 1885.
	Along right bank of Disang .	24·940	11,79,787	47,305	„ 1886.
	Disang to Makum Junction .	25·340	19,66,871	77,619	„ 1885.
	TOTAL .	582·413	5,20,64,688	89,395	
	Deduction for alternative line in North Cachar Hills which effects reduction of 6·788 miles.	6·788	37,97,294	...	
	TOTAL .	575·625	4,82,67,394	83,852	

EDWARD J. MOORE, *M.I.C.E.*,
Executive Engineer in charge
Bengal-Assam Railway.

Enclosure No. 17 to P. W. D. Resolution No. 868 R. C. of 1887.

Note by G. L. Molesworth, Esq., Consulting Engineer to the Government of India for State Railways, dated 27th May 1887.

The results of the survey of the alternative steep gradient line have verified the anticipations of Mr. Buyers, that a saving of 28½ lakhs of rupees may be effected by the adoption of an exceptional gradient of not less than 1 in 40 in the Jatinga Valley.

In fact, the estimate prepared by Mr. Moore shews a saving of 3·9 miles and 32½ lakhs of rupees, but this amount must be reduced, because the introduction of an exceptionally steep gradient must involve some increased expenditure in station staff quarters, station machinery and rolling stock. Making allowance for these, I think that Mr. Buyers' anticipated survey of 28½ lakhs may stand. I think that Mr. Moore and his assistants deserve great credit for the rapidity with which they have carried out this survey in a most difficult country.

With reference to the general question of the estimate of the hill section between Badarpur and Lumding, I am of opinion that, in view of our recent experience in the large increase of quantities, due to slips, and flattening slopes beyond what was considered necessary in the estimates of the Sind-Pishin Railway, and moreover looking to the difficulty in locomotive railways in predicting the relative amount of rock that may be met in the various cuttings or the material in the tunnels, it would be prudent to increase Mr. Buyers' mileage estimate in the hill section from 1½ to 1¾ lakhs per mile. Mr. Buyers' rates are certainly not high. The line has not yet been set out, but the longitudinal section has merely been deduced from cross sections; and as I have already pointed out in my previous note, the country is sparsely populated and unhealthy, labour and supplies will have to be imported, so that it is difficult to predict how the rates may be influenced by an unhealthy season, or by the difficulty of obtaining supplies.

Taking the project as a whole, the figures would stand in round number as follows:—

	Miles.	Rates per Mile.	Cost. Lakhs.
Chittagong to Badarpur	253¾	80,522	204
Badarpur to Lumding	115½	1,75,000	202
Lumding to Mahur	213¼	67,505	144
Gauhati Branch	110½	76,005	84
Total (ruling grade 1 in 70) .	693	91,486	634
Deduction if exceptional gradient of 1 in 40 be introduced	...	...	28½
Total with exceptional gradient of 1 in 40 .	...	...	605½

The case therefore stands as follows:—

The whole project with a ruling gradient of 1 in 70, in the hill section, will cost about 634 lakhs of rupees, which may be reduced to 605½ by the introduction of an exceptional gradient of 1 in 40. The portion affected by the exceptional gradient will be probably about 20 miles, and on this length the increased cost of carrying one ton of goods per mile, due to the exceptional gradient, will probably be about 7 pie or an increase of about 11½ annas on each ton carried as through traffic. Against this there would be a saving on the interest of capital expenditure which, if placed as a set-off against increased working expenses, would vary about as follows:—

With 2 trains each way per day 15 pie per ton.
" 3 " " 10 "
" 4 " " 7½ "
" 5 " " 6 "
" 6 " " 5 "

The introduction of the exceptional gradient would therefore be an economy if the traffic on this railway were small, but it would be the source of an economy if the number of trains each way exceeded four. Looking to the difficulties of raising money in the market for the construction of this line by private enterprise, it may be politic to adopt the exceptional gradient of 1 in 40, with the view of reducing the first capital expenditure as much as possible; but if the future of this railway is expected to be brilliant, if it should largely develope the resources of Upper Assam and cause a large track to spring between that district and the port of Chittagong, then the introduction of the exceptional gradient will be a mistake.

At the commencement, however, it is probable that the traffic on this railway will be limited until the work of development by the railway shall have made due progress.

Enclosure No. 18 to Railway Resolution No. 868 R. C. of 1887.

CHITTAGONG STATE RAILWAY.

This projected Railway, which forms a continuation of the projected main line from Assam and Silchar, commences at Comillah and passes in a southerly direction to Laksam, and thence turns in a south-westerly direction, crossing the Pheni river near its mouth; it then keeps to the strip of country comprised between the Sitakund range of hills and the sea until it reaches Chittagong.

From Laksam it is proposed to construct a branch to Chandpur, on the left bank of the Megna river. It was originally proposed to make the branch to Daudkhandi, but Chandpur is obviously the most suitable position for the terminus of the branch line. The proposed line passes for nearly its whole length over low-lying alluvial land which is nearly a dead flat, the average formation-level at Chandpur being 21 feet above mean sea-level, at Laksam 22 feet, at the Pheni river 24 feet, and at Chittagong 33 feet above mean sea-level, gradients being scarcely necessary, except in the approaches to the bridges over the streams and rivers that have to be crossed.

The Railway has to be in embankment throughout its entire length, in order to keep the formation well above high flood-level. The only work of any magnitude will be the bridge over the Pheni river.

This, according to the proposed alignment, crosses the Pheni where it is almost an estuary of the sea, exposed to the storm-waves of the Bay of Bengal, and I agree with Mr. Horace Bell that it is absolutely necessary to alter the site of this bridge, so as to cross the river higher up, where the bed will be better defined and the country less exposed to the effects of the storm-wave.

With the present alignment, the funnel-shaped channel of the Pheni river enables the storm-wave to attain large proportions; and as the formation-level there appears to be about 5 feet below the level of the storm-wave, except where the line is raised in the bridge approaches, the results of a cyclonic wave would be most disastrous to railway works on that alignment. I have roughly marked in full blue pencil lines on the Index plan, a line which I think might be examined for the crossing of the Pheni river; it would cross the two branches of the river separately more than two miles above the present site, and would involve an additional length of a mile and a half to the through mileage of the Railway, if the present alignment be adhered to, up to the point from which I have marked the line of deviation.

I presume that the alignment, south of Laksam, has been adopted for local reasons connected with the development of the district, but, if not, it would appear that a saving of about 4 miles might be effected, if the upper crossing of the Pheni be adopted, by taking the line from Laksam in nearly a straight line to Dewaniganj, and producing that line to the upper crossing, as I have marked in dotted blue pencil lines on the Index plan.

The question of carrying the Railway through the Halda Valley, instead of skirting the coast, has been carefully considered; and the Executive Engineer of Chittagong has made a reconnaissance with the view of ascertaining whether such a line is feasible; but the crossing of the water-shed which divides the Valley of the Halda from that of the Pheni is attended with difficulties which render the cost of a line through the Halda Valley prohibitory. This crossing would involve at least 7 miles of very heavy work in crossing 6 steep rocky ridges, from 350 to 500 feet in height. The Executive Engineer of Chittagong proposed, as an alternative entrance to the Halda Valley, the tunnelling through the range about 6 miles north of Sitakund; but this entrance would apparently involve tunnelling to an extent of nearly a mile and a half in length, as well as an increase in the length of the through mileage, and in all probability a steeper ruling gradient which under the present alignment is as flat as 1 in 300.

The idea of passing through the Halda Valley may therefore be dismissed as impracticable. The length of the line under the present alignment is 128·56 miles, including the branch to Chandpur. If the upper crossing of the Pheni river be adopted, the length will probably be increased to 130 miles. If, on the other hand, the direct line *viâ* Dewanigan j were adopted, the length might be reduced to 126 miles.

The estimated cost per mile of railway as submitted by Mr. Horace Bell, the Engineer-in-Chief, stands as follows:—

	Rs.
Preliminary Expenses	536
Land	3,000
Earthwork	6,206
Bridging	11,916
Level-crossings	624
Fencing	1,973
Ballast	4,569
Permanent-way	19,350
Stations, &c.	7,310
Workshops	2,497
Staff Quarters	4,176
Station Machinery	2,661
Plant	2,649
Steam Ferries	1,556
Rolling-stock	9,000
Establishment	5,727
Indirect Charges	3,185
TOTAL	87,335

The principal rates upon which this estimate has been based are as follows:—

	Rs.	A.	
Earthwork	6	12	per 1,000 c. ft.
Turfing	2	8	,, sup. ft.
Excavation for foundations	5 to 10	0	,, c. ft.
Rammed filling	9	0	,, ,,
Well sinking	12	0	per lineal ft.
Concrete	28	0	per 100 c. ft.
,, cement	45	0	,, ,,
Brickwork	40	0	,, ,,
,, in cement	65	0	,, ,,
Ironwork	253 to 293	0	per ton.
Timber	4	4	per c. ft.
Fencing	1,750	0	per mile.
Ballast	8	0	per 100 c. ft.
Sleepers	3	4	each.
Laying permanent-way	660	0	per mile.

Some further preliminary expenses will probably be necessary for investigating the question of the alteration of the Pheni bridge site.

With reference to the earthwork, I may remark that the embankments in some cases appear to have been graded at too low a level, but there seem to be some discrepancies in the flood-levels, as marked on the section, which I have not been able wholly to reconcile.

I have prepared a rough diagram which is annexed to this note, to indicate generally the relative position of the formation, and of the high flood-levels between Chittagong and Chandpur. A study of this diagram will enable the situation to be more readily comprehended. In an almost dead level country like that under consideration, it is evident that no very abrupt variations in the high flood-level can exist at places which are not separated by high land, or by artificial embankments, because the high flood level, being above the general level of the country, must equalise itself, unless the flood water of one portion be separated from that of another contiguous portion. Such a case may exist where the cart-road is below the railway alignment; and it is possible that between the 10th and 13th mile from Chittagong the flood water may be held up by the road, whilst beyond the 14th mile, where the alignment crosses the road and keeps below it, the road cannot exert any influence in holding up the flood level; but there does not appear to be any influence of this character about mile 35, and yet in three quarters of a mile distance there is an apparent difference of about 5¼ feet in the high flood level as marked on the section. If the flood level at the 35th mile be correct, it will be necessary to raise the formation level of the greater part of the embankment in the neighbourhood of that part by 4 or 5 feet at least.

Again the high flood level at the Pheni river is nearly on the same level as that of the formation of the embankment about 2 miles distant from the bridge. Again near Chandpur the formation level is shewn to be only about half a foot above high flood level about 2 miles distant. The construction of the Railway will doubtless tend to increase the height of the flood level generally.

In any case it appears to me that the embankments must be raised between the 13th and the 44th mile to a level which *as a minimum* should be 24 feet above mean sea level; and between the 18th and 30th mile of the Chandpur branch to a minimum of 21 feet above mean sea level. The cost of raising the embankments to this extent will be in round numbers about Rs. 1,80,000; but if, on the other hand, the high flood level marked on the section near the 35th mile be correct, then it will probably be necessary to grade the embankments between the 13th and 44th mile to a minimum of 26 feet above mean sea level, and the additional cost of this would be about Rs. 1,20,000, making, with the previous addition, about 3 lakhs of rupees extra to the estimate for the earthwork.

On the other hand, the rates for earthwork, Rs. 6-12 per 1,000 cubic feet, with turfing Rs. 2-8 per 1,000 s. ft., which will probably bring up the cost of earthwork to about Rs. 7-2 per 1,000 cubic feet, appears to be excessive. A rate of Rs. 4-8 or Rs. 5 would appear to be sufficient, and in that case the cost of raising the embankments would be to a great extent counterbalanced by the reduction of the rates. Turfing is certainly unnecessary in Bengal, but if the rates for earthwork cannot be reduced, then the raising of the embankments to the extent above mentioned would add about Rs. 2,300 per mile to the cost of the earthwork.

In considering the question of bridging I may remark that the drainage which affects the railway may be divided into four distinct areas—

1st.—That which has to pass the line between Laksam and Chandpur;

2nd.—That which has to pass into the Little Pheni river.

3rd.—That which has to pass into the Great Pheni river.

4th.—The drainage from the Sitakund range between Chittagong and the 42nd mile.

In the first case the amount of water that must pass the line between Laksam and Chandpur is indeterminate, because the country is dead level, and any water that cannot pass the line will naturally flow into the Megna river.

In the second case the amount of water which drains into the Little Pheni is rendered somewhat doubtful by the fact that the spill waters of the Goomptee river may pass down between Comillah and the high ground to the east, and unite with the drainage proper of the Little Pheni. I think it is possible that it may be found expedient to prevent this contingency, by blocking off the spill waters of the Goomptee by an embankment running from Comillah to the high ground at the base of the Tipperah hills. The length of such an embankment could not be more than 6 or 7 miles, and the cost would probably not exceed Rs. 40,000 or Rs. 50,000, probably less, if existing bunds could be supplemented, and this cost would probably effect more than an equivalent saving in the bridging of the Great and Little Pheni rivers.

Assuming then the exclusion of the spill waters of the Goomptee, the drainage area of the district supplying the Little Pheni river must exceed 300 square miles, but it is probable that any surplus water that could not be taken by the Little Pheni bridge would flow into the Great Pheni river, so that the Pheni river bridges together should be capable of taking the whole of the water from the drainage areas combined.

The atlas sheets, however, do not clearly define the catchment areas of the Pheni river, but, as far as I can ascertain it, the catchment area will not probably exceed 1,000 square miles, making, with the catchment area of the Little Pheni river, a total of about 1,300 or 1,400 square miles, which, according to Dickens' formula ($D = 825 M^{\frac{3}{4}}$), will give a maximum flood discharge of from 180,000 to 190,000 cubic feet per second. Assuming for this a velocity of flood discharge at 5 feet per second, we shall require an area of from 36,000 to 38,000 square feet, and this, with a mean depth of 20 feet in high flood, will require 1,800 to 1,900 lineal feet, or say 18 to 19 spans of 100 feet each. Mr. Horace Bell has provided 24 spans of 100 in the estimates for the Great and Little Pheni bridges, so that his provision will probably be sufficient.

A final decision on the question of the waterway to be given at these bridges must, however, await the further investigation of the proposed alternative site; meanwhile the estimate of Mr. Horace Bell for them may be provisionally accepted.

It may possibly be desirable to prepare alternative estimates for the Pheni bridge with 100 feet spans on wells and for 60 feet spans on cast-iron screw pile piers.

Between Chittagong and the 42nd mile the drainage is to a great extent cut off from the coast by the Sitakund range; consequently the whole drainage area intercepted by the railway on this length cannot far exceed 100 square miles, representing a maximum flood discharge by Dickens' formula of about 26,100 cubic feet per second, which, on the assumption of a flood velocity of 5 feet per second, would require a discharge area of about 5,250 feet. The quantity provided I make out by rough calculation to be approximately about 6,400 square feet, which would appear to be sufficient.

The raising of the embankments will increase the cost of the bridges somewhat, but not to any serious extent, because the majority of the bridges are already in raised embankments.

The amount provided for fencing appears to be low, and will, I believe, require to be increased. The amount provided for stations appears, on the other hand, to be excessive; but it provides for a Jetty at Rs. 2,50,000, Warehouses at Rs. 1,25,000, and General Offices at Rs. 1,80,000. The Jetty and Warehouses will probably be undertaken by the Chittagong Port Trust, and if so, need not be included in the cost of the Railway. The General Offices should be a charge divided over the whole of the Bengal-Assam Railway system.

The amount provided for the workshops appears to be more than necessary, for although it may be decided to construct general workshops for the system at Chittagong, yet the cost of such shops should be divided equally over the whole cost of the system.

The amount provided for Staff Quarters and Station Machinery appears to be excessive, and the necessity for Steam Ferries, as an integral portion of this railway, is not apparent. The amount of Rolling-stock is high, at all events for the first opening of the line before the traffic has developed, and as the bridging, with the exception of that for the Pheni river, is of an insignificant character, I think the amount of plant might be reduced. The works generally, with the exception of the Pheni Bridge, might be pushed through in a very short time, so that I think the establishment would bear reduction.

Taking into consideration the points above mentioned, I should be disposed to place the estimate at the following mileage rates:—

	Rs.
Preliminary Expenses	600
Land	3,000
Earthwork	6,500
Bridging	12,000
Level-crossings	600
Fencing	2,800
Ballast	4,700
Permanent-way	19,500
Stations, &c.	2,000
Workshops	2,000
Staff Quarters	2,500
Station Machinery	1,500
Plant	1,500
Rolling-stock	8,000
Establishment	4,000
Indirect Charges	3,000
TOTAL	74,200

I visited Chittagong in November last on my way to Burma, and I then formed a very favourable opinion of it as a terminal port for the Bengal-Assam Railway system, and as a means of developing the rich district of Eastern Bengal; the port is well sheltered by a double bend in the river, and the large increase, which has of late taken place in the traffic of the port, proves that its advantages are beginning to be appreciated.

17th August 1887. GUILFORD L. MOLESWORTH.

GOVERNMENT OF INDIA.

DEPARTMENT OF FINANCE AND COMMERCE.

PRICES CURRENT OF FOOD-GRAINS THROUGHOUT INDIA FOR THE 1st HALF OF AUGUST 1887.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
		QUANTITIES PER RUPEE IN SEERS OF 80 TOLAS.													
PROVINCES.	DISTRICTS.	Wheat.	Barley.	Rice, best sort.	Rice, common.	Jowar or Cholum (*Sorghum vulgare*).	Bajra or Cumbu (*Pennisetum typhoideum*).	Marua or Ragi (*Eleusine coro-cana*).	Kangni or Kakun, Italian millet (*Setaria italica*).	Gram, Chenna, Chola, Kadalay or Sunaga (*Cicer arietinum*).	Maize (*Zea Mays*).	Arhar or Thúr Cadjan Pea (*Cajanus indicus*).	Firewood.	Salt.	REMARKS.
		S. Ch.	S. Ch.	S. Ch.	S. Ch.	S. Ch.	S. Ch.	S. Ch.	S. Ch.	S. Ch.	S. Ch.	S. Ch.	S. Ch.	S. Ch.	
MADRAS.	Ganjam	10 5	...	14 10	15 8	...	...	29 5	...	...	...	...	215 13	13 13	
	Vizagapatam	12 0	...	9 0	10 3	21 10	23 13	20 3	...	...	...	...	93 5	12 14	
	Godavery	10 6	...	13 14	15 0	19 3	19 6	25 8	...	...	...	...	243 0	12 8	
	Kistna	8 14	...	14 13	16 8	19 0	...	31 5	...	...	...	...	145 13	15 0	
	Nellore	9 0	...	12 14	14 0	23 0	...	29 2	...	...	...	...	93 5	14 13	
	Cuddapah	11 13	...	13 3	14 14	25 5	...	30 0	...	...	...	...	140 0	14 6	
	Anantapur	11 8	...	12 13	15 2	30 14	22 10	32 0	...	...	...	...	77 13	13 2	
	Bellary	11 14	...	12 5	13 0	27 13	25 6	34 0	...	...	...	...	97 3	13 2	
	Kurnool	11 2	...	12 2	12 14	30 8	25 0	...	...	...	...	...	114 6	13 11	
	Madras	10 10	...	11 3	13 0	23 0	23 2	28 0	...	...	...	...	86 5	14 10	
	Chingleput	...	...	14 10	15 2	...	21 2	27 6	...	...	...	...	106 14	14 0	
	North Arcot	10 3	...	13 2	13 8	...	...	32 8	...	...	...	...	140 0	13 11	
	South Arcot	9 6	...	13 14	14 14	...	24 10	25 6	...	...	...	...	201 11	14 6	
	Tanjore	10 5	...	14 8	...	19 2	25 6	27 3	...	...	...	...	166 3	14 11	
	Trichinopoly	...	...	14 0	14 8	...	25 6	26 8	...	...	...	...	133 10	14 10	
	Madura	10 2	...	13 6	13 14	27 8	23 8	27 14	...	...	...	...	131 3	15 0	
	Tinnevelly	9 14	...	11 14	12 6	...	...	...	...	...	...	...	70 0	16 8	
	Coimbatore	13 2	...	13 8	14 8	22 10	25 6	27 14	...	...	...	...	121 8	12 11	
	Nilgiris	10 11	...	11 3	12 0	21 10	19 10	21 10	...	...	...	...	161 13	11 0	
	Salem	12 13	...	13 2	15 0	30 14	31 3	30 13	...	...	...	...	186 10	14 10	
	South Canara	7 6	...	13 10	16 0	...	...	25 0	...	...	...	...	128 5	16 3	
	Malabar	8 10	...	13 13	14 10	...	...	22 10	...	...	...	...	155 8	14 6	
BOMBAY.	Bombay	10 3	16 5	7 4	10 14	18 1	14 4	15 11	13 3	14 14	18 9	8 10	67 1	14 6	
	Daskrohi	No return received.													
	Kaira	11 0	21 6	8 14	9 6	14 1	14 1	20 0	...	16 0	...	10 0	80 0	16 0	
	Surat	12 0	14 0	8 0	10 0	15 0	14 0	...	...	14 0	...	10 0	80 0	16 0	
	Broach	12 0	...	8 0	11 0	16 0	14 0	...	...	13 0	...	13 0	120 0	14 2½	
	Tanna (Salsette)	9 12	...	8 3	10 0	16 13	14 6	...	...	12 5	...	8 0	71 2	15 4	
	Colába (Alibag)	8 9	...	7 4	11 4	...	13 0	...	...	12 7	...	8 2	90 0	14 0	
	Khandesh (Dhulia)	13 8	...	7 8	9 6	20 10	16 12	...	14 8	13 8	...	10 8	131 0	15 4	
	Násik	12 6	...	10 8	12 0	22 0	17 14	25 0	...	17 14	...	9 10	106 8	15 0	
	Ahmednagar	12 8	...	8 0	9 1	24 10	17 12	...	...	18 13	...	15 5	86 12	14 6	
	Poona (City)	11 8	9 0	8 9	9 13	21 12	17 4	16 6	...	17 4	...	14 10	60 13	13 6	
	Sholápur	14 6	19 8	9 8	10 6	26 10	23 4	...	21 2	20 1	...	15 2	80 0	13 0	
	Bijápur	15 6	13 2	7 1	9 12	27 0	28 10	...	...	18 11	...	18 9	80 0	12 1	
	Sátára	12 1	...	9 9	10 12	20 0	20 10	...	...	19 8	...	15 2	93 3	14 3	
	Belgaum	15 0	11 8	10 8	11 0	24 0	23 0	32 0	...	17 0	...	16 0	66 0	13 0	
	Dhárwár (Hubli)	16 0	...	10 0	11 0	25 0	23 0	38 0	...	19 0	...	12 0	80 0	9 0	
	Ratnágiri	9 4	...	8 9	11 5	16 14	15 5	17 1	...	15 6	...	10 14	120 0	12 15	

Karwar	11 0	...	7 0	10 0	16 0	16 0	16 0	12 0	14 0	...	11 8	213 5½	11 0
Pánch Mahâls (Godhra)	9 2	...	8 0	11 3	...	15 2	20 0	...	16 7	18 0	11 0	160 0	13 3
Aden	8 0	...	6 3	8 0	11 3	10 3	...	...	11 3	...	5 9	65 5	32 0
Asirgarh Cantonment	13 8	...	9 0	10 8	18 11	21 0	...	19 0	17 0	...	10 0	160 0	11 0
Baroda Camp (Sadar Bazar)	8 9	13 11½	6 15	9 2	13 11¼	13 2½	15 7	...	12 0	...	10 13½	80 0	13 2½
Disa Cantonment	12 4	...	8 0	9 2	16 0	19 0	...	...	15 12	...	10 4	150 0	14 0
Nimach Cantonment	13 4	18 0	8 0	10 0	25 0	15 0	...	...	17 12	24 0	13 0	180 0	14 0
Nasirabad Cantonment	12 15¼	18 7½	7 0	8 0	18 0	15 3¼	...	10 0	18 4¼	18 9½	12 8	90 0	15 12
Rajkot Station	11 8	...	6 8	9 0	14 0	11 8	...	...	11 8	...	7 8	80 0	40 0
Upper Sind Frontier	11 7	16 0	9 0	...	23 0	18 0	...	...	11 7	...	11 8	128 0	12 8*
Karachi	11 0	18 0	8 0	14 0	20 0	16 0	†	†	14 0	14 0	8 0	85 0	16 0
Haidarabad (Gidu Bunder)	12 8	13 8	10 8	18 8	19 8	17 8	...	...	11 8	...	...	120 0	14 8
Shikarpur	11 14	14 12	10 0	15 0	20 0	22 0	...	...	14 4	...	10 0	120 0	14 2
Sukkur	14 8	19 0	10 0	15 0	22 8	20 8	...	...	16 8	...	11 8	120 0	14 8
Thar & Parkar (Umarkot)	15 9	...	...	16 0	...	19 8	...	...	...	...	...	160 0	14 12
Western Districts.													
BENGAL. Burdwan	15 0	‡	15 0	22 8	...	...	...	...	26 0	‡	29 0	120 0	14 0[a]
Bankoora	13 8	20 0	17 0	22 6½	...	...	...	...	19 8	32 0	20 0	280 0	12 0[b]
Beerbhoom	16 8	...	17 4	22 8	...	...	...	...	26 8	...	15 0	160 0	12 12[c]
Midnapore	13 0	...	18 0	23 0	...	...	...	...	20 0	...	13 0	155 0	13 0[d]
Hooghly	14 0	...	10 0	17 0	...	...	...	...	20 0	...	13 0	120 0	13 8[e]
Howrah	14 8	...	13 4	18 8	...	...	...	...	22 12	...	14 8	100 0	12 13
Central Districts.													
Calcutta	14 4	20 0	8 12	16 4	19 12	16 8	...	15 8	19 14	17 8	18 0	80 0	13 0
24-Pergunnahs	14 0	26 8	8 0	16 13	...	...	...	20 0	22 8	26 8	19 0	90 0	12 8[e1]
Nuddea	16 0	32 0	15 4	20 4	...	...	...	...	29 0	...	20 0	...	11 10¼[f]
Khoolna	...	...	17 0	20 0	...	...	...	...	16 0	...	...	160 0	10 8[g]
Jessore	16 0	...	16 0	21 4	...	...	...	...	21 0§	...	18 0§	100 0	10 12[h]
Moorshedabad	15 0	...	15 0	20 0	...	...	...	...	30 0	40 0	20 0	130 0	12 0[i]
Dinagepore	12 8	22 8	15 8	19 8	...	...	...	...	21 0	...	11 0	160 0	12 8[j]
Rajshahye	16 8	45 0	15 12	18 12	...	...	...	...	28 2	...	16 0	240 0	12 0[k]
Rungpore	18 12	...	14 8	17 12	...	...	...	...	20 0	...	8 10	120 0	10 5[l]
Bogra	17 4	...	15 0	22 8	...	...	...	...	20 4	...	...	90 0	12 0
Pubna	18 0	...	8 0	21 0	...	...	...	...	30 0	...	18 12	200 0	12 0[m]
Darjeeling	9 0	13 0	5 0	13 0	...	...	12 0	...	11 0	16 0	8 0	120 0	9 0[n]
Jalpáiguri	12 0	20 0	13 0	20 0	...	...	...	...	16 10	20 0	12 0	128 0	11 0[o]
Eastern Districts.													
Dacca	14 8	26 0	17 0	20 0	...	...	...	...	20 0	...	18 0	120 0	12 8[p]
Furreedpore	20 0	26 0	18 0	22 0	...	...	...	...	22 0	...	20 0	160 0	12 0[q]
Backergunge	...	...	16 0	18 0	...	...	...	...	18 0	...	12 0	120 0	12 0[r]
Mymensingh	12 8	...	13 5	17 0	...	...	...	...	17 0	...	12 8	...	12 0[s]
Chittagong	10 0	...	12 0	16 13	...	...	...	...	16 0	...	8 0	80 0	8 0[t]
Noakholly	...	...	19 0	21 0	...	...	...	...	13 0	...	...	...	9 0[t1]
Tipperah	12 0	...	18 7	18 13½	...	...	...	...	18 4	...	9 14	...	11 8[u]
Chittagong Hill Tracts	...	...	13 5	14 11	...	...	...	...	...	...	...	320 0	8 0
Hill Tipperah	12 0	...	10 0	16 0	...	...	...	...	12 0	...	16 0	...	11 0

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* In common use.

† Not procurable.

‡ Not in the market.

§ The increase in price is less due to importation.

[a] In sub-divisions retail prices of salt per rupee were:—Culna 12 seers, Cutwa 13 seers, and Raneegunge 12-2 seers.

[b] In Bishenpore retail price of salt 12 seers per rupee.

[c] In Rampore Haut retail price of salt 13 seers 3 chittacks per rupee.

[d] In sub-divisions retail prices of salt per rupee were:—Ghattal 14-4 seers, Tumlook 11 seers.

[e] In sub-divisions retail prices of salt per rupee were:—Serampore 12 seers, and Jehanabad 13-8 seers.

[e1] In sub-divisions retail prices of salt per rupee were:—Baraset 12 seers, Bussirhat 13 seers, Diamond Harbour (at Kulpihat) 10-8 seers, Barrackpore 12-12 seers, and Dum-Dum 11 seers.

[f] In sub-divisions retail prices of salt per rupee were:—Kooshtea 13 seers, Meherpore and Chooadanga 12 seers and Ranaghat 10-14 seers.

[g] In Satkhira and Bagirhat sub divisions retail price of salt 11 seers per rupee.

[h] In sub-divisions retail prices of salt per rupee were:—Jhenida and Narail 12 seers, Magoora 10-12 seers, and Bongong 13 seers.

[i] In sub-divisions retail prices of salt per rupee were:—Lalbagh 13 seers, Jungipore 12-8 seers, and Kandi 12 seers.

[j] In Thakurgaon retail price of salt 10 seers per rupee.

[k] In Nowgong retail price of salt 12 seers per rupee.

[l] In sub-divisions retail prices of salt per rupee were:—Kurigram 12 seers 9 chittacks, Gaibanda 9-12 seers, and Nilphamari 13 seers.

[m] In Serajgunge retail price of salt 12 seers per rupee.

[n] Retail price of salt at Kurseong 8 seers, and Silliguri 10 seers.

[o] In Alipore sub-division (at Fallacotta) retail price of salt 10 seers per rupee.

[p] In sub-divisions retail prices of salt per rupee were:—Manickgunge 11 seers, Munshigunge 10-12 seers.

[q] In sub-divisions retail prices of salt per rupee were:—Goalundo 12 seers, and Madaripore 12-8 seers.

[r] In sub-divisions retail prices of salt per rupee were:—Patuakhali 9 seers 9 chittacks, Perozepore 11 seers, and Bhola 10-8 seers.

[s] In sub-divisions retail prices of salt per rupee were:—Kishoregunge 9-2 seers, Attea 12 seers, Jamalpore 10-10 seers, Sherpore 10 seers and Netrokona 10 seers.

[t] In Cox's Bazar sub-division retail price of salt 8 seers per rupee.

[t1] In Fenny sub-division (at Panchgatchia hât) retail price of salt 9 seers per rupee.

[u] In sub-divisions retail prices of salt per rupee were:—Brahmunberiah 13 seers and Chandpore 11-8 seers.

PRICES CURRENT OF FOOD-GRAINS THROUGHOUT INDIA FOR THE 1st HALF OF AUGUST 1887—*continued.*

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
		QUANTITIES PER RUPEE IN SEERS OF 80 TOLAS.													
PROVINCES.	DISTRICTS.	Wheat.	Barley.	Rice, best sort.	Rice, common.	Jowar or Cholum (*Sorghum vulgare*).	Bajra or Cumbu (*Pennisetum typhoideum*).	Marua or Ragi (*Eleusine coracana*).	Kangni or Kakun, Italian millet (*Setaria italica*).	Gram, Chenna, Chola, Kadalay or Sunaga (*Cicer arietinum*).	Maize (*Zea Mays*).	Arhar or Thur Cadjan Pea (*Cajanus indicus*).	Firewood.	Salt.	REMARKS.
	Behar.	S. Ch.	S. Ch.	S. Ch.	S. Ch.	S. Ch.	S. Ch.	S. Ch.	S. Ch.	S. Ch.	S. Ch.	S. Ch.	S. Ch.	S. Ch.	
BENGAL—*continued.*	Patna	19 0	28 0	11 8	21 8	26 0	26 0	26 0	24 0	30 0	32 0	26 0	120 0	11 12	
	Gya	16 0	29 0	9 8	18 8	...	...	...	17 0	28 0	...	22 0	150 0	11 0	
	Shahabad	16 0	26 0	9 0	16 0	...	...	...	...	27 0	...	16 0	120 0	12 8[v]	
	Durbhunga	19 12	30 12	12 0	17 3	...	...	30 2	...	30 2	33 0	22 0	176 0	12 0[x]	
	Mozufferpore	20 0	30 0	12 0	19 0	...	...	30 0	...	30 0	24 0	21 0	120 0	12 0[x]	
	Sarun	15 0	27 0	8 4	20 8	...	†	28 0	15 0	26 0	29 0	26 8	160 0	12 0[y]	
	Chumparun	20 0	36 0	7 8	16 0	...	...	8 0	...	31 0	32 0	...	...	12 0[z]	
	Monghyr	18 15	33 8	13 10	17 5	...	...	...	33 9	30 8	35 10	24 2	126 0	13 2[z1]	
	Bhágalpur	19 4	32 12	16 6	18 15	...	...	...	...	29 0	32 5	27 7	151 8	12 10[z2]	
	Purneah	16 0	...	16 0	17 0	...	...	20 0	25 0	20 0	...	18 0	160 0	10 8[z3]	
	Maldah	17 0	...	13 0	22 0	...	...	...	...	28 0	...	...	120 0	11 8	
	Sonthal Pergunnahs	13 4	...	10 0	25 0	...	...	...	...	21 0	38 0	26 0	200 0	11 8[z4]	
	Orissa.														
	Cuttack	15 12	...	11 13	18 6	...	...	...	...	17 1	...	15 12	80 0	14 0	
	Pooree	10 8	...	13 2	22 5	...	...	...	...	13 2	...	14 7	70 0	14 7[z5]	
	Balasore	13 0	13 0	15 0	25 0	...	...	..	...	16 0	...	10 0	160 0	10 8[z6]	
	CHOTA NAGPORE. *South-Western Frontier Agency.*														
	Hazáribágh	17 0	17 0	9 0	16 0	*	...	32 0	*	22 0	28 0	21 0	240 0	10 0[z7]	
	Lohardugga	20 0	24 0	16 0	20 0	..	...	36 0	...	19 0	...	28 0	120 0	9 12	
	Singbhoom	20 0	32 0	20 0	24 0	...	...	...	...	16 0	...	20 0	320 0	9 0	
	Manbhoom	17 0	...	18 6	26 0	...	...	...	...	16 0	...	21 0	...	10 10	
ASSAM.	Sylhet	11 8	...	12 4	17 8	...	...	...	...	17 8	...	11 12	108 0	12 0	
	Cáchár	8 0	...	8 14½	16 0	...	...	...	...	16 0	...	11 6½	80 0	11 6½	
	Goálpará	20 0	...	8 0	20 0	...	...	...	...	16 0	...	11 0	80 0	11 0	
	Gáro Hills	8 0	...	6 0	13 0	...	...	...	...	10 0	...	9 0	160 0	8 0	
	Kámrup	9 8	...	8 0	18 8	...	...	...	...	14 0	...	11 8	160 0	11 4	
	Darrang	7 0	...	10 0	13 0	...	...	...	...	13 0	...	10 0	150 0	10 0	
	Nowgong	8 0	...	8 0	14 0	...	...	...	...	9 0	...	10 0	120 0	10 0	
	Sibsagar	...	...	12 0	14 0	...	...	...	...	14 0	...	10 0	120 0	9 8	
	Lakhimpur	8 0	...	9 0	13 0	...	...	...	...	11 0	8 0	10 0	160 0	8 0	
	Khási and Jaintiá Hills	...	...	6 4	9 0	...	...	...	...	9 0	16 0	7 4	90 0	8 0	
	Nágá Hills	...	...	3 6	8 0	...	...	...	...	3 6	...	3 8	60 0	3 8	
	Dehra Dún	No return	received.												
	SahárANPUR	15 3	22 9	8 10	11 14	15 1	10 12	19 5	21 5	18 12½	19 5	19 5	129 0	12 12	
	Muzaffarnagar	17 0	24 6	6 9	12 2	19 12	15 6	16 8	15 6	21 0	22 0	14 5	132 0	13 0	
	Meerut	15 8	23 8	6 0	14 0	14 0	16 0	18 0	18 0	21 0	18 0	25 0	100 0	13 8	
	Bulandshahr	17 4	25 0	6 0	10 0	20 0	15 0	...	16 0	24 0	24 0	19 0	160 0	13 0	
	Aligarh	16 4	23 0	6 4	12 0	19 0	15 8	...	16 0	23 8	26 8	30 0	140 0	14 0	
	Kumaun	13 0	14 0	10 0	10 8	...	...	17 0	20 0	13 0	...	10 0	200 0	8 0	
	Garhwál	14 8	21 0	7 8	12 0	25 0	...	...	...	10 8	...	8 8	180 0	7 8	

N.-W. PROVINCES.	Bijnor	15 12	25 0	10 2	11 10	...	...	...	...	19 6	...	...	135 0	12 2
	Moradabad	16 14	24 12	9 4	12 12	16 0	...	...	14 8	22 8	...	26 4	125 0	13 6
	Budaun	16 12½	25 3	6 0	13 3	...	13 3	...	...	23 6½	24 0	28 3	192 0	12 9½
	Bareilly	15 0	20 0	6 4	11 14	18 12	16 14	...	15 0	20 0	23 12	23 12	137 8	12 13
	Sháhjahánpur	16 0	22 8	10 0	14 8	...	...	...	20 0	21 0	...	22 8	140 0	12 8
	Tarái Pergunnahs	16 14	25 0	8 12	12 8	13 12	15 0	...	15 0	18 12	25 0	20 0	100 0	11 4
	Muttra	14 8	19 8	7 0	12 0	16 0	16 0	...	...	19 0	20 0	25 0	120 0	13 0
	Agra	14 8	19 8	5 0	10 0	17 0	16 0	...	14 0	20 0	...	15 0	100 0	13 0
	Farukhabad	15 4	19 0	6 8	10 12	...	...	...	...	20 8	...	23 0	140 0	12 4
	Mainpuri	15 4	20 4	4 8	9 8	...	...	35 0	16 0	20 14	...	22 8	160 0	12 12
	Etáwah	15 0	17 0	6 0	12 8	17 8	17 8	16 0	16 0	21 0	25 0	24 0	120 0	12 0
	Etah	16 4	23 4	7 0	11 8	18 0	15 8	...	15 8	23 12	...	26 8	173 8	13 8
	Jalaun	No return received.												
	Jhánsi													
	Lalitpur	16 4	23 0	10 0	11 8	22 0	20 0	32 0	32 0	24 0	24 0	11 0	160 0	10 0
	Cawnpore	16 4	21 0	10 0	14 0	21 0	21 0	...	25 0	23 4	‡	26 0	150 0	14 0
	Fatehpur	14 4	19 12	12 0	13 0	...	...	...	...	22 4	...	27 0	160 0	11 8
	Bánda	21 8	25 8	8 0	12 8	24 8	19 0	30 0	20 0	30 0	...	22 0	160 0	12 0
	Allahabad	13 10	22 0	8 0	13 0	16 0	16 0	...	16 0	27 0	...	19 0	120 0	11 8
	Hamirpur	20 14	...	9 0	12 8	23 0	23 0	...	...	29 6	...	34 8	140 0	11 8
	Jaunpur	14 0	19 10	7 0	12 12	...	...	...	...	22 6	...	23 12	140 0	12 0
	Gorakhpur	15 5	23 13	10 6	16 3	...	...	...	25 3	27 0	...	16 0	140 0	12 6½
	Basti	No return received.												
	Azamgarh	14 0	19 3	10 5	14 12	...	...	...	...	22 8	...	13 10	177 8	11 2
	Mirzapur	15 0	24 0	8 0	15 0	18 0	18 0	24 0	20 0	22 0	24 0	25 0	80 0	11 0
	Benares	13 13	19 8	10 13½	15 7	17 5½	16 13	...	22 12	21 15	19 8	22 12	110 0	11 13
	Gházipur	16 12	22 8½	7 1½	15 7	19 5	21 4	36 1	18 0	27 0½	...	23 3	128 12	10 15½
	Balia	18 0	27 0	9 4	18 8	...	...	...	...	29 8	...	23 4	100 0	12 0
	Pilibhit	15 0	23 12	12 8	13 12	10 0	...	...	...	19 4	...	23 12	140 0	11 4
OUDH.	Sultánpur	15 0	20 8	9 0	13 0	13 0	16 0	40 0	20 0	22 0	13 0	23 0	160 0	12 0
	Partábgarh	16 3	22 0	13 0	14 0	...	...	...	...	23 2	...	18 5	180 0	11 2
	Fyzabad	14 8	22 8	10 0	15 0	11 0	16 0	12 0	14 0	23 8	20 0	21 8	100 0	11 8
	Kheri	16 0	26 0	8 0	13 0	22 0	22 0	36 0	24 0	20 0	24 0	18 0	120 0	12 0
	Lucknow	15 0	20 8	6 0	12 8	22 0	20 0	...	18 0	20 8	23 0	23 8	110 0	11 8
	Bára Banki	14 0	19 0	8 0	12 0	20 0	16 0	21 0	16 0	19 0	20 0	22 0	120 0	11 8
	Bahraich	16 0	27 0	13 0	17 0	25 0	20 0	...	...	27 0	27 0	25 0	160 0	12 0
	Raí Bareli	15 0	19 0	7 0	13 0	13 0	15 0	...	16 0	21 0	...	25 0	180 0	11 0
	Sitapur	16 12	23 8	8 0	13 0	19 0	18 0	18 0	17 0	22 0	23 0	24 8	160 0	12 8
	Gonda	16 12	24 4	13 12	14 12	14 0	16 8	23 0	18 0	24 8	23 8	27 4	200 0	14 4
	Unáo	15 0	18 0	9 0	13 0	16 0	18 0	...	22 0	21 0	18 0	18 0	160 0	12 0
	Hardoi	17 8	22 0	7 0	13 0	...	...	...	...	22 0	...	27 8	120 0	12 0
PUNJAB.	Hissar	16 0	22 0	...	10 0	24 0	20 0	...	...	28 0	20 0	...	120 0	12 8
	Rohtak	15 0	20 0	...	11 0	16 0	15 0	...	...	27 0	16 0	...	120 0	12 0
	Gurgaon	16 0	22 0	...	11 0	20 0	19 0	...	15 0	22 0	21 0	23 0	140 0	12 0
	Delhi	15 0	21 0	...	14 0	17 0	17 0	...	16 0	23 0	18 0	24 0	80 0	12 0
	Karnál	16 0	22 0	...	11 0	16 0	14 0	20 0	16 0	23 0	16 0	20 0	140 0	12 4
	Umballa	18 0	20 0	...	12 0	10 0	10 0	20 0	16 0	21 0	20 0	20 0	140 0	14 0
	Simla	12 0	16 0	...	9 0	13 0	11 0	18 0	10 0	13 0	14 0	11 0	70 0	10 0
	Kángra	16 0	24 0	...	12 0	14 0	10 0	18 0	10 0	16 0	16 0	12 0	120 0	11 0
	Hoshiárpur	17 0	20 0	...	10 0	18 0	9 0	...	16 0	19 0	20 0	13 0	120 0	14 0
	Jullundur	17 0	20 0	...	8 0	16 0	13 0	...	20 0	19 0	20 0	...	110 0	14 8
	Ludhiána	18 0	22 0	...	12 0	17 0	13 0	...	16 0	22 0	18 0	13 0	120 0	16 0

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* Not procurable. † Not grown. ‡ No sales in market.

v In sub-divisions retail prices of salt per rupee were :—Sasseram 12 seers, Bhabooah 10-12 seers, and Buxar 12-8 seers.

w In sub-divisions retail prices of salt per rupee were :—Tajpore 12 seers and Madhubani 11 seers.

x In sub-divisions retail prices of salt per rupee were :—Seetamarhee 11 seers and Hajeepore 12-4 seers.

y In Sewan and Gopalgunge sub-divisions retail prices of salt 12 seers per rupee.

z In Bettiah sub-division retail price of salt 11-8 seers per rupee.

z1 In sub-divisions retail prices of salt per rupee were :—Beguserai 11 seers and Jamui 11-8 seers.

z2 In Banka, Madehpoora, and Soopole sub-divisions retail price of salt 11 seers per rupee.

z3 In Kishengunge and Arrareah sub-divisions retail price of salt 10 seers per rupee.

z4 In sub-divisions retail prices of salt per rupee were :—Deoghur, Pakour and Rajmehal 12 seers, and Godda 11 seers.

z5 In Khorda sub-division retail price of salt 12 seers per rupee.

z6 In Bhuddruck sub-division retail price of salt 9-8 seers per rupee.

z7 In Giridih sub-division (at Kharagdiha) retail price of salt 11 seers per rupee.

PRICES CURRENT OF FOOD-GRAINS THROUGHOUT INDIA FOR THE 1st HALF OF AUGUST 1887—*continued.*

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
		QUANTITIES PER RUPEE IN SEERS OF 80 TOLAS.													
PROVINCES.	DISTRICTS.	Wheat.	Barley.	Rice, best sort.	Rice, common.	Jowar or Cholum (*Sorghum vulgare*).	Bajra or Cumbu (*Pennisetum typhoideum*).	Marua or Ragi (*Eleusine coracana*).	Kangni or Kakun, Italian millet (*Setaria italica*).	Gram, Channa, Chola, Kadalay or Sunaga (*Cicer arietinum.*)	Maize (*Zea Mays*).	Arhar or Thur Cadian Pea (*Cajanus indicus*).	Firewood.	Salt.	REMARKS.
		S. Ch.	S. Ch.	S. Ch.	S. Ch.	S. Ch.	S. Ch.	S. Ch.	S. Ch.	S. Ch.	S. Ch.	S. Ch.	S. Ch.	S. Ch.	
PUNJAB—*continued.*	Ferozepore	16 0	22 0	...	11 0	18 0	...	...	16 0	21 0	10 0	13 0	90 0	14 8	
	Mooltan	13 0	17 0	...	10 0	17 0	14 0	...	16 0	17 0	16 0	...	100 0	15 0	
	Jhang	14 0	18 0	...	10 0	7 0	13 0	12 0	8 0	15 0	12 0	10 0	200 0	14 0	
	Montgomery	17 0	20 0	...	10 0	10 0	11 0	...	16 0	20 0	11 0	12 0	200 0	12 0	
	Lahore	15 0	22 0	...	11 0	16 0	12 0	...	16 0	19 0	13 0	12 0	100 0	14 0	
	Amritsar	16 0	23 0	...	11 0	10 0	14 0	12 0	16 0	20 0	14 0	16 0	90 0	15 0	
	Gurdáspur	18 0	28 0	...	14 0	10 0	12 0	...	10 0	20 0	12 0	8 0	120 0	15 0	
	Siálkot	16 0	23 0	...	11 0	11 0	13 0	20 0	6 0	19 0	15 0	12 0	130 0	15 0	
	Gujrát	16 0	22 0	...	12 0	14 0	14 0	...	12 0	18 0	16 0	12 0	120 0	16 0	
	Gujránwála	16 0	22 0	...	12 0	12 0	10 0	25 0	10 0	19 0	14 0	8 0	110 0	15 0	
	Shahpur	13 0	18 0	...	10 0	13 0	14 0	20 0	18 0	15 0	15 0	10 0	240 0	16 0	
	Jhelum	15 0	21 0	...	12 0	15 0	15 0	...	...	19 0	16 0	12 0	140 0	16 0	
	Ráwalpindi	14 0	22 0	...	9 0	18 0	16 0	...	12 0	19 0	16 0	21 0	96 0	15 8	
	Hazára	14 0	22 0	...	11 0	...	12 0	...	8 0	15 0	15 0	...	120 0	12 0	
	Pesháwar	14 0	21 0	...	10 0	12 0	14 0	...	17 0	16 0	17 0	19 0	100 0	39 0	
	Kohát	12 0	19 0	...	13 0	14 0	15 0	...	16 0	13 0	16 0	...	80 0	55 0	
	Bannu	14 0	22 0	...	8 0	15 0	13 0	8 0	8 0	16 0	18 0	11 0	60 0	40 0	
	D. I. Khán	12 0	17 0	...	9 0	16 0	13 0	15 0	5 0	15 0	12 0	12 0	113 0	35 0	
	D. G. Khán	13 0	16 0	...	9 0	17 0	15 0	10 0	10 0	15 0	15 0	11 0	125 0	21 0	
	Muzaffargarh	14 0	17 0	...	12 0	12 0	12 0	...	...	15 0	...	11 0	100 0	14 0	
CENTRAL PROVINCES.	Saugor	17 6	...	7 15	9 4	...	...	...	...	22 12	...	...	160 0	9 0	
	Damoh	21 5	...	10 0	11 7	...	...	...	...	26 11	...	12 13	200 0	9 13	
	Jubbulpore	16 8	...	9 0	12 8	20 0	...	...	...	21 0	...	14 8	120 0	11 0	
	Mandla	22 0	...	11 0	13 0	...	...	...	...	30 0	...	16 0	256 0	10 8	
	Seoni	20 6	...	8 15	10 15	...	...	...	...	21 5	...	10 14	200 0	10 11	
	Narsinghpur	16 0	...	9 3	10 8	...	...	...	...	21 11	...	13 7	140 0	9 2	
	Hoshangabad	16 0	...	...	...	...	...	...	...	21 13	...	13 14	200 0	10 14	
	Nimár	15 1	...	7 8	11 14	20 11	...	...	...	16 2	...	12 3	120 0	12 9	
	Betúl	16 12	...	8 12	10 0	20 3	...	...	...	21 0	...	9 12	320 0	...	
	Chhindwára	16 13	...	10 0	12 5	20 9	...	...	...	25 5	...	12 0	160 0	9 2	
	Wardha	16 0	...	8 0	11 7	21 13	...	...	...	16 0	..	13 5	124 0	10 11	
	Nágpur	16 4	...	...	...	19 11	...	...	...	17 13	...	13 2	109 0	11 7	
	Chánda	16 3	...	...	12 4	20 3	...	...	...	14 8	...	10 8	615 0	10 8	
	Bhandára	16 4	...	10 0	11 4	...	...	...	...	16 4	...	11 4	180 0	10 8	
	Bálaghát	17 1	...	11 13	16 9	...	...	...	...	16 13	...	15 0	144 0	10 0	
	Raipur	21 0	...	9 0	16 10	...	...	...	...	21 0	...	21 0	64 0	9 0	
	Biláspur	24 6	...	13 8	20 4	...	...	...	...	31 6	...	21 14	128 0	6 8	
	Sambalpur	20 2	...	14 0	16 10	...	...	...	...	18 12	...	11 0	180 0	9 10	
	Arakan Division.														
	Akyab	8 0*	...	13 0	16 0	...	...	...	...	11 0	...	...	150 0	20 0	
	Kyoukpyu	...	...	16 9	18 4	...	...	...	...	5 0	†	...	50 0	42 0	
	Sandoway	...	...	26 13	30 13	...	...	...	...	...	...	...	469 11	22 13	

LOWER BURMA.	*Pegu Division.*													
	Rangoon Town	11 2	...	10 6	12 6	...	...	...	...	15 2	19 8‡	...	275 0	29 2
	Pegu	...	...	8 14	11 3	...	...	...	...	11 2	...	...	135 0	26 15
	Tharrawaddy	...	...	11 14	14 5	...	...	...	...	11 1	...	...	535 11	29 12
	Prome	12 2§	...	11 3	13 12	...	...	...	...	13 13	33 9	...	167 9	18 10
	Irrawaddy Division.													
	Bassein	...	...	13 9	15 14	...	...	...	...	12 1	20 12	...	255 1	26 13
	Henzada	...	...	10 4	15 10	...	...	...	...	...	...	...	183 8	35 8
	Thongwa	...	...	9 6	10 9	...	...	...	...	12 14	...	...	246 0	35 0
	Thayetmyo	10 0	...	10 3	11 14	...	...	...	...	12 5	...	...	367 8	18 15
	Tenasserim Division.													
	Moulmein Town and Amherst	9 0	...	11 8	12 2	...	...	...	...	10 2	12 2	...	220 0	30 8
	Tavoy	...	...	13 0	17 15	...	...	...	...	...	...	...	399 3	16 1
	Mergui	...	...	15 6	16 10	...	...	...	...	...	...	...	428 0	14 9
	Toungoo	...	...	9 14	11 10	...	...	...	...	9 7	...	...	27 0	18 12
	Shwaygyin	...	...	9 13	10 10	...	...	...	...	...	...	...	250 0	18 14
HYDERABAD ASSIGNED DISTRICTS.	Secunderabad	12 11	*Nil*	6 13	10 14	18 13	20 1	*Nil*	*Nil*	14 7	*Nil*	11 8	115 0	9 13
	Bolarum	13 3	*Nil*	7 1	9 13	20 4	...	*Nil*	*Nil*	15 15	*Nil*	*Nil*	116 14	10 4
	Chadarghat	9 4	...	7 8	10 0	19 0	22 0	*Nil*	...	14 0	...	12 8	120 0	9 8
	Amráoti	14 0	...	7 8	9 3	22 4	18 0	...	...	14 4	...	11 0	*a*	12 0
	Akola	14 0	...	7 0	10 0	20 0	18 0	...	...	14 0	...	15 0	*a*	11 0
	Ellichpur	14 0	9 0	7 0	9 0	21 0	15 0	...	...	13 4	...	10 0	*a*	11 0
	Buldana	16 0	...	8 0	10 0	23 0	22 0	...	...	17 0	...	10 0	*a*	10 0
	Wún	15 0	...	8 0	10 0	25 0	...	...	...	12 0	...	18 0	*a*	11 8
	Básim	17 5	...	6 13	9 10	27 0	30 0	...	...	15 10	...	18 8	*a*	9 10
MYSORE.	Bangalore	11 0	12 0	9 11	11 0	26 7	...	35 0	...	12 3	...	18 10	84 0	11 0
	Kolar	...	12 0	12 0	11 8	...	...	40 0	...	12 0	...	...	144 0	10 4
	Túmkúr	11 0	11 0	13 0	14 0	...	...	48 0	...	13 0	...	20 0	340 0	10 0
	Mysore	10 0	10 8	11 8	13 4	40 0	32 0	38 0	12 0	12 0	...	16 4	81 0	10 0
	Hassan	...	12 0	14 0	16 0	...	...	48 0	...	14 0	...	12 0	320 0	11 0
	Shimoga	12 10	13 10	12 10	15 12	31 8	...	52 8	...	16 13	...	...	480 0	9 7
	Kadur	10 0	12 0	18 0	20 0	...	...	48 0	...	14 0	...	12 0	320 0	11 0
	Chitaldroog	13 0	14 0	10 8	14 0	40 0	20 0	48 0	50 0	12 0	...	15 0	320 0	9 0
COORG	Coorg	10 0	9 0	13 8	16 0	...	...	39 8	...	24 8	...	...	110 0	11 0
RAJPOOTANA.	Jeypore	12 8	21 8	5 0	8 12	18 8	18 0	...	18 0	20 0	21 0	25 0	110 0	15 0
	Kishengurh	12 4	20 8	9 0	10 0	23 12	14 0	...	...	20 12	18 4	...	...	16 0
	Kerrowlee	12 3	16 4	10 0	11 4	14 11	13 2	...	18 12	14 6	...	20 0	200 0	12 13
	Ulwur	15 8	21 3	8 0	11 10	17 0	16 4	...	19 0	21 3	21 8	26 0	200 0	14 12
	Bhurtpore (City)	13 15	18 3	7 6	8 4	14 8	16 11	...	13 4	19 0	14 0	18 0	200 0	12 4
	Ajmere	11 8	18 8	3 0	8 0	17 0	15 0	...	...	18 0	17 0	...	70 0	14 0
	Deoli Cantonment	13 12	17 7	5 8	9 0	21 8	18 0	...	...	15 2½	...	...	230 0	13 0
	Erinpura	12 8	22 6	...	9 0	20 0	21 0	...	...	18 6	...	...	260 0	14 0
	Sirohee	11 0	19 0	6 0	8 0	18 0	22 0	...	20 0	18 0	18 0	14 0	160 0	12 0
	Abu	10 12	16 4	6 0	8 0	...	17 8	...	...	15 0	18 0	...	...	12 0
	Anadra	11 1	18 4	6 8	8 0	...	20 0	...	...	16 0	20 0	...	...	12 12
	Bálmere	9 12	...	5 0	9 0	...	24 8	...	...	13 0	...	...	300 0	13 8
	Jeysalmere	9 0	...	9 10	12 0	15 0	14 4	...	...	12 0	...	...	...	25 9
	Hilly Tracts of Meywar	11 8	23 0	...	12 8	...	...	...	...	18 0	24 0	...	*b*	11 8
	Meywar (Oodeypore)	12 1¾	17 3	9 6	10 2¼	16 12¾	11 10½	*Nil*	12 8	13 4½	17 15½	10 8¾	200 0	10 8¾
	Bánswára (Meywar Agency)	16 4	17 8	8 12	15 0	...	...	...	...	25 0	20 0	...	...	10 15
	Partábgarh (,,)	15 0	18 12	10 0	12 8	21 14	...	...	...	18 12	21 14	25 0	...	18 15
	Marwar (Jodhpore)	12 4	20 10	6 4	7 8	21 4	18 12	...	...	18 12	20 0	...	...	16 4

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* Arhar Rs. 8-0. † None in the market this fortnight ‡ Dhall 3 annas per viss. § Arhar Rs. 9-5. *a* Firewood is sold by head-load, bullock-load, cart-load, and not by weight. *b* Eight pies per bundle.

PRICES CURRENT OF FOOD-GRAINS THROUGHOUT INDIA FOR THE 1st HALF OF AUGUST 1887—*concluded*.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
PROVINCES.	DISTRICTS.	QUANTITIES PER RUPEE IN SEERS OF 80 TOLAS.													REMARKS.
		Wheat.	Barley.	Rice, best sort.	Rice, common.	Jowar or Cholum (*Sorghum vulgare*).	Bajra or Cumbu (*Pennisetum typhoideum*).	Marua or Ragi (*Eleusine coracana*).	Kangni or Kakun, Italian millet (*Setaria italica*).	Gram, Chenna, Chola, Kadalay or Sunaga (*Cicer arietinum*).	Maize (*Zea Mays*).	Arhar or Thúr, Cadjan Pea (*Cajanus indicus*).	Firewood.	Salt.	
		S. Ch.	S. Ch.	S. Ch.	S. Ch.	S. Ch.	S. Ch.	S. Ch.	S. Ch.	S. Ch.	S. Ch.	S. Ch.	S. Ch.	S. Ch.	
RAJPOOTANA—*contd.*	Bikanir	10 12	...	3 15	8 1	...	15 4	...	...	12 11	...	8 8	100 0	14 0	
	Boondee	15 4	21 0	9 8	10 0	21 0	...	...	...	18 0	...	...	...	...	
	Kotah	14 12	16 0	7 8	10 0	18 0	12 8	...	...	19 0	10 0	12 8	240 0	11 4	
	Tonk	13 11	19 11½	8 6	9 6	19 14	...	...	...	19 2	...	...	...	...	
	Jhallawar	14 11	17 14	7 1	10 4	22 6	17 10	...	14 2½	16 3	22 2	10 4	175 0	10 13	
	Shahpoora	No return received.													
	Dholpur	13 11	18 0	9 9	11 13	17 9	16 8	...	16 14	19 9	...	21 8	90 0	13 3	
CENTRAL INDIA.	Indore	12 13	17 0	8 9	10 0	21 14	19 3	...	...	16 8	20 0	15 8	100 0	11 0	
	Gwalior	13 8	19 0	7 4	9 9	17 14	17 3	...	10 14	17 15	...	19 15	135 15	11 6	
	Goona	18 0	20 0	9 0	9 8	25 0	18 0	...	...	25 0	24 0	13 0	200 0	11 0	
	Baghelkhand (Sutna)	18 8	30 0	8 0	15 0	...	16 0	...	...	26 0	...	31 8	140 0	52 0	
BALUCHISTAN.	Quetta	10 8	12 0	5 0	10 8	17 0	*Nil*	*Nil*	*Nil*	12 0	*Nil*	*Nil*	53 5	11 0	

DEPARTMENT OF FINANCE AND COMMERCE,
(Statistical Branch).

E. T. ATKINSON.
Offg. Secretary to the Government of India.

GOVERNMENT OF INDIA.

DEPARTMENT OF FINANCE AND COMMERCE.

SUPPLEMENT TO THE STATEMENTS OF PRICES CURRENT (RETAIL) OF FOOD-GRAINS FOR THE 2nd HALF OF JUNE 1887 PUBLISHED IN PAGE 970 OF THE SUPPLEMENT TO THE "GAZETTE OF INDIA," DATED 23rd JULY 1887.

PROVINCE.	DISTRICTS.	AVERAGE WAGES PER MONTH.		
		Able-bodied Agricultural labourer.	Syce or Horse-keeper.	Common Mason, Carpenter, or Blacksmith.
		R a. p.	R a. p.	R a. p.
MADRAS	Ganjam	3 8 0	6 0 0	12 0 0
	Vizagapatam	1-8 to 6-0	1-8 to 10-0	4-8 to 20-0
	Godavery	5 0 0	5 0 0	14 0 0
	Kistna	6 0 0	7 0 0	15 0 0
	Nellore	5 0 0	6 0 0	5-10 to 15-0
	Cuddapah	7 8 0	7 8 0	15 0 0
	Anantapur	3-8 to 5-0	3-0 to 6-0	9-0 to 15-0
	Bellary	4 0 0	6 0 0	15 0 0
	Kurnool	4 11 0	4 11 0	18 12 0
	Madras	5 0 0	5-0 to 6-0	12-3 to 15-0
	Chinglept	4 8 0	6 0 0	13-8 to 15-0
	North Arcot	4 0 0	5 0 0	14-0 to 17-0
	South Arcot	4 11 0	5 0 0	14 11 0
	Tanjore	2 14 10	5 0 0	13 2 0
	Trichinopoly	5 8 0	6 8 0	12 3 0
	Madura	5 0 0	7 8 0	20 0 0
	Tinnevelly	2-8 to 7-0	4-0 to 7-0	7-0 to 18-12
	Coimbatore	7 8 0	7 8 0	18 12 0
	Nilgiris	7 0 0	8 8 0	24 8 0
	Salem	2 3 5	6 0 0	14 8 0
	South Canara	6-4 to 7-8	6 to 7-8	15 to 22-8
	Malabar	6 9 0	5-0 to 7-0	16 14 0

E. T. ATKINSON,

Offg. Secretary to the Government of India.

DEPARTMENT OF FINANCE AND COMMERCE,
(*Statistical Branch*).

GOVERNMENT OF INDIA.

REVENUE AND AGRICULTURAL DEPARTMENT.

WEATHER SUMMARY FOR AUGUST, 1887.

As in the previous month, the weather during August was of the normal monsoon character. In fact over Northern India, owing to the increased strength of the current from the Bay of Bengal, the rainfall was heavier and of greater extent than during July, and those districts of the Punjab, where dry hot weather had previously prevailed, have during August received fairly abundant rainfall. As a general rule the precipitation has taken the form of steady continuous rain, and not only have there been no breaks in the rains of any importance in any part of India, but the exceptionally heavy local falls, which characterize the weather of some years at this season, have been exceedingly few during the present August.

The monsoon.—At the commencement of the month the monsoon current on the West Coast was exceptionally strong, and westerly to south-westerly winds of more than normal strength were blowing over Rajputana, the Berars, Central India, and the Central Provinces. This strong current held until the 7th when the wind decreased quickly on the West Coast, south of Bombay, though it continued to blow very strongly across the Cutch and Guzerat Coasts. This decrease proved, however, to be only temporary, and disappeared as quickly as it had come, so that, by the morning of the 9th, the monsoon current was above its normal velocity along the whole West Coast, though more so between Bombay and Kurrachee than along the Peninsula Coast. These strong steady monsoon winds continued to blow all along the West Coast and far into the Central parts of the country until the 28th, when the current became weaker on the Malabar and Bombay Coasts, and the wind directions there exhibited a slight northerly element. In Sind and Cutch there was no change. These conditions lasted until the close of the month.

The Bay of Bengal current was, on the whole, much less steady than that from the Arabian Sea, but was much stronger and steadier and extended further inland, than was the case with the same current during July. The month commenced with a well-marked southerly wind blowing from the Bay across Arakan and East Bengal and an easterly wind over Assam and North Bengal. By the 2nd the current from the Bay had become more distinct. A strong southerly wind blew across the Bengal Coasts, backed to south-east and east in North and West Bengal, and with that direction penetrated up the Gangetic plain to the Punjab. These favourable conditions continued only for a day or two, when the monsoon current again became feeble and unsteady, and westerly winds from the Arabian Sea advanced into Bengal, and the Bay current instead of travelling north-westward was deflected towards Assam. On the 11th westerly winds more or less disappeared from the Gangetic plain, and normal easterly and south-easterly winds reappeared. These conditions lasted with occasional interruptions until quite the close of the month, and it is probably to this favourable easterly current that the general and abundant rain over Upper India is mainly due.

Pressure.—The mean barometric pressure of the month is below the August average at several stations in Southern India, and at a few in Sind and in Burma, but elsewhere it is above, the greatest excess being in Bengal. Pressure has, as a rule, been very steady during the month, and the absence of any considerable storms is probably the cause of the generally high barometer, which has prevailed.

Storms.—As mentioned in the preceding paragraph, no storms of any magnitude have traversed the country during the month, but small local depressions have frequently formed, giving a cyclonic circulation to the winds in their neighbourhood and more or less heavy rain. On the 1st a well-marked disturbance was shown lying between Calcutta and Burdwan; this disturbance subsequently travelled north-westward to Benares where it filled up. On the 16th a feeble depression was formed over the head of the Bay, whence it advanced west-north-west towards the Ganjam Coasts, which it crossed on the morning of the 19th. It gave heavy rain to some Coast stations, but was, on the whole, a small and unimportant disturbance. It reached Raipur on the morning of the 20th, after which it filled up. On the 21st there were indications of the formation of another depression in the north-west angle of the Bay. This disturbance subsequently travelled on a north-west course as far as Agra, where it also filled up. Other shallow depressions have appeared in different parts of the Indian area during the month, but they have all been of small size and intensity and exceedingly short-lived.

Temperature.—The weather generally has been cool—only at a few places in Burma, Lower Bengal, Assam, and the south of the Peninsula, and at the stations of Jacobabad and Multan has the mean temperature of the month exceeded the average. In all other places the mean temperature has been below the normal. In parts of the North-Western Provinces, Rajputana, and the Punjab the deficiency was between 4° and 5°, in the Central Provinces and Central India about 2°, and elsewhere generally between 1° and 2°. In the Indus Valley the day temperatures continued high, the mean maximum at Dera Ismail Khan being 102·8° and at Mooltan 100·5°.

Humidity.—Humidity was above the average, except in East and Lower Bengal, Sind, and Malabar Coast.

Rain.—Rain fell in all parts of India during the month. In the Derajat, in Sind, and in the extreme south of the Carnatic the amounts were small, in several instances not exceeding 1 inch, but the general distribution and extent of the rainfall during August was an improvement on that in July. In the Punjab, the North-Western Provinces, North Bengal, the whole of the Central parts of the country, the Konkan, Mysore, the Carnatic, and Ceylon the total fall was in excess of the average, while in Behar, Assam, Burma, Lower Bengal, Orissa, and the Deccan there was a slight, and in Sind, Guzerat, and Malabar a considerable deficiency.

Exceptionally heavy falls of rain occurred at Chittagong (8½ inches) on the 8th, at Allahabad (7½ inches) on the 9th, at Ludhiana and Jullundur (6 inches) on the 14th, at Fyzabad (6 inches) on the 17th, and at Mussoorie (18 inches) on the 21st and 22nd.

With regard to the seasonal fall the report for the last day of August shows that since June 1st there has been generally deficient rainfall throughout Burma, Bengal, and Assam, and the east of the North-Western Provinces; an excess of rain over the remainder of the North-Western Provinces, Rajputana, the Central parts of the country, and the Punjab, except the stations of Peshawar and Mooltan, a deficiency in Malabar and Mysore, an excess in Bombay, a deficiency in Sind, and irregular variations in Madras.

The following table shows the amount of rain and the difference from the average, during the month of August, 1887, according to districts as far as is indicated by the telegraphic reports :

Districts.	Number of Stations.	Average Rainfall for August.	Difference from the Average in August, 1887.
Punjab, West	7	5·70	+ 2·33
„ East	6	8·47	+ 5·06
North-Western Provinces, Trans-Gangetic	14	13·00	+ 5·63
„ „ Cis-Gangetic	7	8·92	+ 6·45
Behar	4	10·12	— 1·18
Northern Bengal	3	18·06	+ 2·66
Assam—Cachar	5	14·34	— 1·46
Lower Bengal—Chutia Nagpur	7	13·99	— 0·46
Orissa—Northern Circars	6	8·58	— 0·36
Central Provinces, South	7	11·94	+ 4·24
Berar—Khandesh	3	5·88	+ 0·39
Rajputana, Central India—Saugor and Narbudda	10	11·12	+ 4·48
Sind—Cutch	4	2·12	— 1·14
Guzerat	4	8·46	— 4·52
Konkan	4	14·04	+ 0·89
Deccan—Hyderabad	8	5·82	— 0·26
Malabar	5	19·49	— 7·56
Mysore—Bellary	6	4·22	+ 1·66
Carnatic	8	3·34	+ 1·14
Lower Burma	7	22·83	— 3·85
Ceylon	2	4·87	+ 0·62

W. L. DALLAS,

SIMLA, *5th September, 1887.*

for *Meteorological Reporter to the Government of India.*

GOVERNMENT OF INDIA.

REVENUE AND AGRICULTURAL DEPARTMENT.

Weather Review of India for the week ending the 31st August, 1887.

The meteorological conditions of the past week have been such as is normally experienced at this period of the rains, that is, the weather has shown a slight but general tendency to improve, and both the extent and amount of rainfall has slowly decreased. The monsoon currents on both sides of the Peninsula have been fairly steady, but the amount of moisture they have brought up has apparently been relatively slight and the weather generally has been showery rather than wet.

On the 25th strong monsoon winds continued on the Bombay Coast, more particularly in Guzerat and Cutch, where, owing to the indraught towards the depression near Jhansi, winds of from 12 to 16 miles per hour were experienced. Most of the rainfall connected with this branch of the monsoon fell over the region traversed by this portion of the current, and amounts exceeding an inch were reported from Neemuch, Deesa, Mount Abu, and Ajmere. There was very little change on the following day, though except at Mount Abu the rainfall was lighter. On the 27th there occurred a sudden rise in the velocity of the winds at the Ceylon stations and in Malabar, but elsewhere in the West, there was no change of importance. The weather was showery, but no heavy falls of rain were reported. The report of the 28th showed that except on the Sind Coast, where the wind had an average velocity of 19 miles per hour, the monsoon on the West Coast had become much weaker and at the same time veered towards North-West, both indications of the growing unsteadiness of the current. Notwithstanding this weakness fairly general rain fell in Bombay and the Central Provinces, and some heavy showers in Central India and Rajputana. Jeypore received 3½ inches, and Nowgong and Hoshangabad over 1 inch. On the 29th the monsoon current had become steadier again, and was quite up to its average velocity all along the West Coast. It had given general rain to the Central Provinces and Bombay, and some heavy showers to Central India and North Madras. The principal falls were Neemuch and Masulipatam about 3 inches, and Goa and Karwar about 2 inches. On the 30th winds fell lighter on the Bombay Coast, and again exhibited a tendency to veer to North-West. Local heavy showers occurred at some places, but, on the whole, the area of rainfall was restricted. On the 31st there was but little change. A striking feature about the West Coast monsoon during the past week has been the great steadiness and strength of the wind on the Sind at Cutch Coasts.

In the Bay of Bengal, as was the case last week, the monsoon current has suffered several interruptions. On the 25th a strong current was blowing from the Bay into Bengal, and showers were reported from Burma and Assam, but only slight rain in Bengal. These conditions continued during the 26th, but on the 27th a slight depression was developed at the head of the Bay occasioning a feeble cyclonic circulation of the winds at the Coast stations, with moderate rain and light unsteady winds in North Bengal, and Behar with no rain. By the next day the depression had disappeared and south-easterly winds of light force were re-established in Lower Bengal. In consequence of this change moderate rain was received over the whole of Bengal and the east of the North-Western Provinces. On the 29th the wind increased without altering its direction, so that a strong set blew up the Gangetic Valley, and several places in Northern India received heavy showers of rain. There was very little change on the 30th, but the winds were rather lighter and some parts of Northern India were without rain. On the 31st the monsoon current from the Bay and up the Gangetic plain was light and unsteady, and light local showers only were received in Burma, Bengal, Behar, and the North-Western Provinces.

The weather in Upper India has been very unsettled. Continuous rain has nowhere been experienced, but heavy local showers have alternated with periods of fair weather. On the 27th, Murree received 1¼ inches and Rawalpindi 2½ inches; on the 28th, Allahabad received 2¾ inches; Bareilly, Roorkee, and Ludhiana over 1 inch; and on the 29th Mussoorie received 9 inches, while the weather on the 25th and 26th, the 30th and 31st was generally fine.

Pressure has been above the average of the month everywhere, while temperature, on the contrary, has been almost equally generally below it. The greatest deficiency of temperature was at the Punjab hill stations and in Rajputana, where it considerably exceeded 2°. The amount of moisture in the atmosphere was generally in excess of the normal.

Regarding the rains as a whole, the report for August the 31st shows that since the 1st of June there has been general but comparatively unimportant deficiency in Bengal, Assam, and the east of the North-Western Provinces, and a considerable excess in Oudh, the west of the North-Western Provinces, and the Punjab, except the Indus Valley. In Sind and the south of the Peninsula the season's rainfall is also short, but over the whole of the Central parts of the country and the Bombay Coast the rains have been exceptionally heavy. The following table gives for a few representative stations the amount of rain since June 1st, the average for the same period, and the difference:

Stations.		Total Rainfall since June 1st, 1887.	Average Rainfall, June 1st to August 31st.	Difference.
Akyab	...	109·44	133·10	—23·66
Saugor Island	...	41·03	43·13	— 2·10
Calcutta	...	34·89	38·76	— 3·87
Dhubri	...	41·25	51·88	—10·63
Purneah	...	34·12	41·05	— 6·93
Gya	...	26·69	29·73	— 3·04
Allahabad	...	31·04	26·15	+ 4·89
Meerut	...	19·05	18·58	+ 0·47
Delhi	...	31·30	17·18	+14·12
Lahore	...	14·89	11·10	+ 3·79
Peshawar	...	1·94	4·92	— 2·98
Cochin	...	54·82	72·21	—17·39
Ratnagiri	...	88·47	84·49	+ 3·98
Bombay	...	72·34	56·99	+15·35
Poona	...	16·87	17·32	— 0·45
Surat	...	35·66	30·88	+ 4·78
Khandwa	...	27·60	23·30	+ 4·30
Nagpur	...	40·61	29·98	+10·63

The concluding table gives the total rainfall for the past week:

Divisions.		No. of Stations.	Total Rainfall.
Burmah	...	6	15·53
Bengal and Assam	...	15	27·44
North-Western Provinces and Oudh	...	9	20·55
Punjab	...	6	7·53
Hill Stations	...	5	17·47
Ceylon	...	2	1·72
Malabar Coast	...	5	12·31
Bombay	...	9	23·41
Berars and Central Provinces	...	10	18·06
Guzerat and Central India	...	6	16·45
Sind—Rajputana	...	3	17·17
Madras	...	13	21·42

W. L. DALLAS,

SIMLA, *2nd September, 1887.*

for *Meteorological Reporter to the Government of India.*

E. C. BUCK,

Secretary to the Government of India.

GOVERNMENT OF INDIA.

REVENUE AND AGRICULTURAL DEPARTMENT.

REPORTS ON THE STATE OF THE SEASON AND PROSPECTS OF THE CROPS FOR THE WEEK ENDING 8th SEPTEMBER, 1887.

GENERAL REMARKS.—Rain in varying quantities has fallen throughout the country. The falls were lightest in the Punjab and Bombay.

The *kharif* crops are generally thriving everywhere, though in some Provinces, notably in Rajputana, the Central Provinces, and the North-Western Provinces and Oudh, they have been injured by excessive rain.

Operations for the *rabi* season have commenced in Bombay, the North-Western Provinces and Oudh, the Punjab, and the Central Provinces.

In Madras, Mysore and Coorg agricultural prospects are generally satisfactory.

The rice crops in Bombay, Bengal, the Central Provinces, Assam, and Burma are on the whole promising, though more rain would be beneficial in places.

Sugarcane is doing well in Bengal and Assam.

The public health is generally good in all Provinces.

Prices are rising in Mysore. Elsewhere they remain fairly stationary.

Presidency or Province and District.	Rainfall for week under report.	State of agricultural prospects.
Madras—(Sept. 7th.)		
Bellary . . .	Average last week since revised, ·04; this week, ·88.	Standing crops generally good, but young early crops withering in parts of one taluk. Cholera decreasing in four and cattle-disease increasing in two taluks.
Kurnool . . .	Average 2·43	Standing crops good Small-pox in two, and cattle-disease decreasing in four taluks. Slight cholera.
Ganjam . . .	Average 2·65	Agricultural operations nearly completed. Small-pox and fever in six, and cattle-disease increasing in seven divisions. Slight cholera.
Kistna . . .	Average 2·27	Agricultural operations progressing. River 6·3 feet over Anicut. Slight fever, cholera decreasing in two, and cattle-disease increasing in four taluks.
Chingleput (Madras) .	Average 1·60	Standing crops fair. Harvest paddy, outturn middling. Small-pox in one, cholera in two and cattle-disease increasing in five taluks.
Coimbatore . . .	Average ·52	More rain wanted. Standing crops generally good, but *cholum* affected by insects in one taluk. Harvest dry grains, outturn above average. Fever in one taluk.
Tanjore . . .	Average last week since revised, 1·57; this week, 2·16.	Standing crops generally good, but require more rain in parts of one taluk. Harvest *cumbu* and gingelly, outturn below average. Cattle-disease increasing in two taluks.
Madura . . .	Average last week since revised, 1·22; this week, 1·60.	Standing crops fair. Cattle-disease in one taluk.
Malabar . . .	Average 1·48	More rain wanted. First crop paddy ripening. Harvest paddy, outturn average. Slight small-pox in seven, fever in two and cattle-disease increasing in three taluks.
Travancore . .	2·82	Harvest of first crop paddy almost over. Fever in parts. *General Remarks.*—General prospects fair.
Bombay—(Sept. 7th)		
Karachi . . .	. . . . . .	River at Kotri on 5th, 16 feet 8 inches against 18 feet 1 inch on same date last year. *Kharif* crops injured in Shahbandar taluka by turtles and rats. Fever in nine and cattle-disease in one taluka. Wheat, red rice, and *bajri* in Karachi 22, 30 and 32 and in Tatta 22, 31 and 34 pounds per rupee, respectively.
Hyderabad . . .	Rain in three talukas	*Kharif* cultivation in progress. Fever in six and slight cattle-disease in three talukas. *Jowari* in places in Kandiani attacked by insects. River falling rapidly, height at Kotri on 5th, 16 feet 8 inches against 18 feet 1 inch on same date last year. Wheat 24, *jowari* 36, *bajri* 33½, white rice 18 and red rice 26 pounds per rupee.
Ahmedabad . . .	·40; total 24·48	Rain throughout the district. Standing crops good. Cattle-disease in Gogha, Parantej and Daskroi talukas. Seven cases of cholera in the city, of which 5 were fatal. Wheat 28 and *bajri* 29 pounds per rupee.
Baroda . . .	1·80; total 43·72	Public health fair. Standing crops in good condition. *Bajri* 26, wheat 19, and rice 30 pounds per rupee.

Presidency or Province and District.	Rainfall for week under report.	State of agricultural prospects.
Bombay—*contd.*		
Surat	Rain in nine talukas—maximum in Pardi, 3·90 and minimum in Chorasi, ·41.	Weeding progressing. *Jowari* and cotton crops suffered in places from excessive moisture; other standing crops healthy. Cattle healthy. Fever in Bardoli and Jalalpur. Cholera in Bardoli, Chikli and Bulsar talukas, 61 cases, 25 deaths. *Jowari* 32 and *nagli* 43 pounds per rupee.
Nasik . . .	Rain maximum in Igatpuri, 4·87 and minimum in Dindori, ·07.	Sowing and transplanting completed. Crops healthy. *Udid* and *khurashni* crops damaged on account of excessive rain in Peint. Land being prepared for *rabi* sowing. Rain wanted in Sinnar and Baglan. Want of fodder is felt in Sinnar and Baglan. Cholera in Nasik, Chandor, Nandgaon, Malegaon and Baglan, total attacks 124, deaths 52.
Colaba (Bombay) . .	Rain every day, except on 6th; total of week, 2·98; total to date, 73·97, being 13·46 above average.	Abnormal temperature rose from 4° cool on 31st to 1° cool on 3rd and was *nil* from 4th to 6th. Vapour in air normal. Abnormal wind easterly on 31st August, and 1st, 5th and 6th September; wind normal on all other days. Thunder and lightning on 31st August.
Poona	. . . . . .	No report received.
Ahmednagar . .	Sheogaon, 3·32; Kopargaon, 1·80; Rohuri, 1·23; and in Shrigonda, ·52; very slight rain in five and none in two talukas.	*Kharif* crops generally fair, except in Karjat and Sangamner, where rain is much needed. *Rabi* sowings begun in Nagar only. Cholera attacks 255, deaths 113. *Bajri* 36 and *jowari* 57 pounds per rupee.
Sholapur . . .	Sholapur, 2·17; Barsi, ·77; Karmala, ·21; Madha, ·88; Pandharpur, 2·36; Sangola, ·85; and Malsiras, ·65.	*Kharif* crops doing well. *Rabi* sowing in progress. Rain required in Malsiras and Karmala talukas. Cholera cases 90, fatal 34. *Jowari* 58⅗ and *bajri* 52⅙ pounds per rupee.
Dharwar . . .	Rain at all stations, except Navalgund, Ranibennur and Kod talukas, and Nargund and Mundarghi Pethas, varying from 1·19 in Gadag to ·05 in *Hubli*.	Young rice, *jowari* and minor crops withering for want of rain. Heavy showers urgently required both for standing crops and for sowing of cotton. Slight cholera in Nargund, Bankapur and Kalghatgi, and slight cattle-disease in Dharwar. *Jowari* 56 and rice 24 pounds per rupee.
Kanara . . .	Rain in Karwar, 4·60; total 118·22; Kirwatti, 2·95; Sirsi; ·80; and Haliyal, ·31.	Rice crop healthy. Slight cattle-disease in two talukas and Mungod Petha. Common rice in Karwar and district average 11 seers per rupee.
Rajkot . . .	2·77; total 26·81	Weather hot and cloudy. Prevailing diseases—fever and bowel-complaints; one cholera case in Navanagar. Wheat 23, *bajri* 24 and *jowari* 28 pounds per rupee.
		General Remarks.—Rain in most districts, more still required in parts of the Deccan and Southern Mahratta Country. Crops suffering from insufficiency of moisture in parts of Shikarpur and Upper Sind frontier, and damaged by rats and insects in parts of Karachi and Hyderabad, and by excessive moisture in parts of Gujarat and Nasik. Scarcity of fodder in two talukas of Nasik. *Rabi* sowing in progress in parts of four districts. Cholera in parts of seventeen, cattle-disease in parts of thirteen, fever in parts of eleven, and small-pox in parts of four districts. Cholera ceased in Baroda.
Bengal—(Sept. 7th)		
Chittagong (Sept. 6th)	·94	Weather hot. *Aus* harvested, outturn good. *Aman* still being transplanted. Prices high. Cholera reported, public health otherwise good.
Dacca	·94	Prospects of crops continue good. Harvesting of jute continues. *Aus* nearly reaped. Transplanting of winter rice still going on. Public health good.
24-Pergunnahs (Calcutta).	1·06	Prospects of *aus*, jute, and sugarcane good, those of *aman* not so favourable for want of rain. Harvesting of *aus* continues. Transplantation of *aman* going on. Public health fairly good.
Khoolna . . .	2·91	Weather hot. Occasional rain. Transplanting of *aman* continues slowly for want of rain. *Aus* being harvested. Public health fair.
Moorshedabad . .	1·95	Weather hot. Rain at intervals. Harvesting of *bhadoi* paddy almost over. *Aman* growing well. Sowing of *til* commenced in some places. Sugarcane and jute progressing. Public health good.
Pubna	2·81	Weather seasonable. Rivers risen. Prospects of crops and general health good.
Dinagepore . . .	8·40	Rain on six days, heavy on 4th. *Bhadoi* and jute being harvested. Transplantation of *aman* nearly completed.
Rungpore . . .	7·09	Prospects of crops fair. Fever prevalent.
Midnapore . . .	1·65	Prospects of crops good.

Presidency or Province and District.	Rainfall for week under report.	State of agricultural prospects.
Bengal—*contd.*		
Burdwan	2·44	Winter rice now suffering much from deficient rain in Culna and Cutwa, elsewhere prospects good. Autumn paddy being cut, outturn fair. Cholera and fever continue in Sadr.
Bhagalpur	3·77	*Bhadoi* harvest yielding fairly. Late rice doing well.
Purneah	7·09	All crops doing well. *Bhadoi* giving fair outturn. *Aghani* being transplanted Rivers high Health bad.
Durbhanga	3·69	*Bhadoi* harvest continues. Rice transplantation still going on. Prospects very favourable. Public health generally good, but fever reported.
Chumparun	7·38	Prospects of crops good. Rain of the week has much benefited them. Prices stationary. Public health fair.
Patna	1·15	Harvesting of *bhadoi* crops still going on. Rain wanted for paddy crop. Crops on *dearah* lands in Dinapore subdivision have suffered from floods of the Soane and Ganges. Cholera still reported from Behar and Dinapore, but decreasing.
Gya	1·65	*Bhadoi* being harvested. Prospects of paddy better than last week. More rain wanted. Cases of fever have increased. Cholera still reported.
Hazareebagh	Good rain at Head-quarters and neighbourhood.	Want of rain reported from several thanas. Indian-corn being harvested. Rice and other crops doing well. So far general health fair.
Cuttack	1·47	*Beali* being reaped with moderate outturn. Prospects of *sarad* good, but more rain wanted. Cholera still continues.
		General Remarks.—Heavy rain reported in the northern districts, but showers only in the rest of the Province. More rain much needed for *aman* crop in many parts. Transplantation not yet quite finished. *Aus*, jute, and other autumn crops are being harvested with general outturn. Sugarcane promising. General health fair, though in some districts fever and cholera reported.
N.-W. Provinces and Oudh—**(Sept. 7th)**		
Benares (Sept. 6th)	Average 1·90	Weather bright. Agricultural prospects fair. Supplies plentiful. Prices steady. Health good.
Ballia („ 5th)	Heavy rain on the 4th.	Weather cloudy. Prospects favourable. Market steady. General health good.
Gorakhpore („ „)	1·30 at Sadr	Prices stationary. Cholera has nearly disappeared.
Fyzabad („ 6th)	Averaging 4·10	*Kharif* crops promising. Weeding in progress. Supplies ample. Cholera disappearing. Slight cattle-disease.
Lucknow („ 5th)	4·10 at Sadr	Break much needed. Supplies sufficient. Prices steady. Cholera nearly disappeared. Condition of cattle good.
Rai Barelli („ „)	Good rain all over the district, a break wanted now.	Prices slightly rising. Cholera still lingering. Cattle-disease reported from some villages.
Partabgarh („ 6th)	Heavy rain	*Kharif* somewhat injured by excessive rain. Prices rising. No cholera.
Allahabad („ „)	Average 2·50	*Jowari* and cotton slightly damaged by excessive rain, otherwise crops looking well. Markets well supplied. Prices stationary. A little fever, but cholera has almost disappeared. General health good.
Cawnpore („ „)	Rain in all, but one tahsil from ·20 to 1·90.	Crops in lowlands injured by continuous and heavy rains. *Rabi* ploughing commenced in places. Prices of wheat and gram slightly risen. Cholera abating, fever in two and cattle-disease in three parganas.
Farakhabad („ „)	Averaging 1·10	Crops thriving except in lowlands. Maize and indigo being cut. Supplies ample. Prices rising. Cholera decreasing. Some fever and ague in places. Cattle-disease in one tahsil.
Sitapur („ „)	Good rain has fallen	*Kharif* prospects are favourable. Cholera still lingers in two tahsils.
Bareilly („ „)	Ample rain	Crops in excellent condition. Prices slightly lower. Slight cholera in two villages. General health of men and cattle good.
Banda („ 5th)	Rain abating	Weeding of *kharif* crops and ploughing for *rabi* going on. Prices stationary. Cholera disappearing. Fever prevalent.
Kumaon („ 6th)	. . . .	Crops in excellent condition. Prices falling. Cholera has ceased. Health good. Cattle-disease almost ceased.
Agra („ 5th)	From 2·20 to 5·80	*Kharif* crops much injured and *rabi* ploughings delayed by heavy and continuous rain. Prices steady. Cholera decreasing,
Jhansi („ „)	Heavy rain	Crops doing well on light soils but injured on black soils. Prices rising. Cholera disappearing. Some fever reported.
Meerut („ 6th)	General rain from 1·60 to 4·40.	Break now commenced. Some damage to *kharif* crops from excessive rain reported. Slight rise in prices. Cholera and fever still prevalent.
		General Remarks.—Again the rainfall has been ample and in some districts the crops have been injured by excessive moisture. Weeding of *kharif* going on; *rabi* ploughing commenced in places. Agricultural prospects promise well. Supplies ample and prices fairly steady. Public health generally good. Cholera is fast disappearing. Outside the Meerut division fever is reported and slight cattle-disease.

Presidency or Province and District.	Rainfall for week under report.	State of agricultural prospects.
Punjab—(Sept. 7th)		
Hissar (Sept. 6th)	. . . .	Fever prevalent. Prices falling. *Rabi* ploughings in progress. *Kharif* prospects good.
Delhi	3·83	Health fair. Prices rising. *Kharif* crops damaged by rain.
Umballa	·75	Prices stationary. *Kharif* crops in good condition.
Jullundur	1·80	Health good. Prices stationary. *Kharif* prospects good.
Ferozepore	1·10	Health good. Prices stationary.
Amritsar	1·20	Health good. Prices stationary. *Kharif* crops good.
Sialkot	Slight rain	Prices stationary. *Kharif* crops good.
Lahore	1·70	Prices stationary. *Rabi* ploughings progressing.
Multan	. . . .	Health good. Prices stationary. *Kharif* prospects good.
Rawalpindi	1·60	Health good. Prices stationary. *Kharif* prospects good.
Shahpur	Rain has fallen	Health good. Prices stationary. *Rabi* ploughings commenced. *Kharif* prospects improved.
Dera Ismail Khan	. . . .	Health good. Prices almost stationary. *Kharif* sowings completed.
Peshawar	Slight rain	Prices fluctuating. *Kharif* prospects average.
		General Remarks.—Rain has been general, except in Hissar, Multan, and Dera Ismail Khan. Health good, except in Hissar, where fever is prevalent, and in Delhi, where health is fair. Cholera decreasing. Prices are falling in Hissar, rising in Delhi, and fluctuating in Peshawar; elsewhere stationary. *Kharif* crops generally good, but crops in Delhi damaged by rain. *Rabi* ploughings in progress in Hissar, Lahore and Shahpur. Cattle-disease in Pathial, Jullundur district.
Central Provinces—(Sept. 7th)		
Nagpur	4·64	Weather showery, break wanted for *jowari* and cotton. Slight cholera and fever prevalent.
Jubbulpore	3·96	Weather warm and clear. Prospects favourable. Fever prevalent. Prices steady.
Saugor	2·55	Weather clear and warm. Cholera continues. Weeding in progress. Prices unchanged.
Seoni	6·43	Weather showery, break much needed. *Rabi* ploughing retarded. Cholera continues. Prices slightly fallen.
Hoshangabad	4·08	Break wanted. Weeding stopped. Fever slightly prevalent. Prices unchanged.
Khandwa	3·00	Weather cloudy and warm. Prospects good. Cholera continues. Prices steady.
Bilaspur	2·58	Rice, cotton, and sugarcane doing well; *til* and *urd* sowing continues. Fever and cattle-disease prevalent. Prices slightly fallen.
Raipur	2·11	Weather close and cloudy. Weeding nearly completed. Crops healthy. Fever in places. Prices stationary.
Sambalpur	. . . .	No report received.
		General Remarks.—Prospects favourable, except of cotton and *jowari*. Break needed in central and southern districts. Fever prevalent.
Burma—(Sept. 7th)		
Akyab (Sept. 3rd)	5·04 (Total rainfall to date 131·92).	Ten cases of cholera in town and 2 in district. Slight cattle-disease. Crop prospects favourable.
Bassein	2·57 (Total rainfall to date 74·26).	Slight cattle-disease in one township. Ploughing and transplanting far advanced.
Rangoon	2·67 (Correct total rainfall to date 80·65).	
Amherst (Moulmein) (Aug. 27th)	5·22 (Total rainfall to date 138·31).	Ploughing and transplanting progressing. Prospects of crops good.
„ (Sept. 3rd)	·48 (Total rainfall to date 138·79).	Ploughing and transplanting progressing. Prospect of crops good.
Tavoy	2·90 (Total rainfall to date 147·22).	Crops reported very healthy.
Pegu	2·71 (Total rainfall to date 101·70).	Ploughing and transplanting nearly finished.
Henzada	2·53 (Total rainfall to date 57·14).	Transplanting completed.
Prome	·66 (Total rainfall to date 27·01).	Slight cattle-disease in two townships. Planting and ploughing progressing.
Toungoo	3·40 (Total rainfall to date 61·42).	Transplanting progressing.
Thayetmyo	1·29 (Total rainfall to date 19·82).	Ploughing and transplanting resumed.

Presidency or Province, and District.	Rainfall for week under report.	State of agricultural prospects.
Burma—*contd.*		
Shwebo (Aug. 27th)	·66 (Total rainfall to date 26·16).	
(Sept. 3rd)	·94 (Total rainfall to date 27·10).	
Kyaukse . . .	. . . .	Condition of crops good.
Myingyan . . .	·56 (Total rainfall to date 15·47).	Food-supply sufficient. Prices ordinary.
Mandalay . . .	1·0 Total rainfall to date 25·76)	Transplanting of *Kyaukki* crops progressing. Food-supply sufficient. Prices normal.
Minbu . . .	1·10 (Total rainfall to date 16·08).	Prices normal.
Yamethen . .	·49 (Total rainfall to date 20·17).	Cultivation progressing.
		General Remarks.—Some cholera in Akyab and Thongwa. Cattle-disease in five Lower Burma districts. Agricultural operations proceeding. Reports from ten Upper Burma districts. Health satisfactory. Anthrax and cattle-disease prevalent in Pyinmana, where rain is much wanted.
Assam—(Sept. 7th)		
Gauhati (Sept. 6th)	3·01	Weather rainy. Public health fair. Malarial fever still prevalent in Sastra, Barpeta and its vicinity, also in parts of Polasbari, Luki and Chomoria tahsils. Cattle-disease still continues in some parts of the district. More rain wanted for *sali* crops. Prospects of crop good.
Sylhet	2·12	Crops doing better since rain has fallen, but more rain is required. Reaping of *aus* and transplantation of *sali* still going on. Tea prospects good. Eight deaths from cholera in Karimganj. Some fever in south Sylhet and Habiganj.
Cachar	3·80	Weather dry. Prospects of rice crop good. Tea doing well. Fever reported from Chatta. Rice selling at 17 seers 12⅗ chittacks per rupee.
Dibrugarh . . .	4·08	Weather seasonable. Tea and sugarcane doing well. Land being prepared for *mati kalai*. Public health indifferent.
Mysore and Coorg—(Sept. 7th)		
Bangalore . . . Mysore . . .	Civil and Military Station, 2·44; Bangalore district head-quarters, 2·35; Mysore, 1·63; Kolar 5·13; rainfall reported heavy in Tumkur.	Standing crops in good condition, except in parts of the Kadur and Hassan districts, where they are reported to be failing for want of more rain. Prospects of season continue favourable. Public health generally good. One case of cholera reported in the Tumkur district, one in Bangalore town, and three in the Civil and Military Station. Prices have slightly risen in the Shimoga, Kadur, and Hassan districts.
Mercara . . .	5·49	Prospects and health good. Rain deficient for rice transplanting in parts.
Berar and Hyderabad—(Sept. 7th)		
Amraoti . . .	·10	Weather close and cloudy. Weeding continues. Crops promising fairly. Cholera in places. Wheat 15 and *jowari* 25 seers per rupee.
Akola . . .	·32	Weather warm and cloudy. Crops in good condition. Weeding in progress. Cholera and fever still prevalent.
Hyderabad . . .	1·50 (Total since 1st January, 16·46).	*Kharif* crops thriving. Water in tanks still insufficient for wet cultivation. General health fair. Prices—wheat 11¼, coarse rice 12, white *juar* 18¼, yellow *juar* 20¾ and *tur* 14 seers per current sicca rupee.
Central India States—(Sept. 7th)		
Indore . . .	1·87; (Total to date 31·83).	Weather oppressive and thundery.
Morar (Gwalior) . .	1·82	Health good.
Sutna . . .	·34	
Neemuch . . .	·60	Health good. Cholera has disappeared. *Makka* crops slightly damaged.
Goona . . .	4·18	Prices rising. Health good.
Agar . . .	1·63	Health and prospects fair. Slight cholera in Ujjain.
Sehore . . .	1·12	*Jowari* crops mostly failed. Occasional cases of cholera in the city and surrounding country, one case in bazaar.
Nowgong . . .	5·26	Weather cloudy. Cholera disappearing in Nowgong. Crops likely to be damaged by continuous rain. Prices steady.
Bhopawar . . .	. . . .	Cases of cholera reported from Sirdarpore, Ranapur in Jhabua, Bagode and Barwai. Prices slightly increasing.

Presidency or Province and District.	Rainfall for week under report.	State of agricultural prospects.
Rajputana—(Sept. 7th)		
Abu (Sept. 7th)	·24	Weather clear and seasonable, with passing clouds.
Sirohi („ 4th)	·97	Tanks fairly full; wells good. Crops good. Weather fine.
Marwar („ 3rd)	. . . . . .	Cholera still prevails. *Kharif* suffering from insufficient rain in some districts. Weather partially cloudy. Market easy. Prices rising.
Meywar („ „)	1·46	Tanks and wells full. *Makki* crops slightly suffered from excessive rains in some districts. Health fair. Prices slightly cheaper.
Pertabgurh . . .	. . . . . .	No report received.
Harowti (Sept. 3rd)	Deoli, 1·02; Tonk, 3·89.	Crops improved by partial break in rain. Health good. Prices risen.
Jhallawar („ 4th)	1·79	Further reports of damage to crops by flood. Health fair.
Ajmere („ 6th)	Average ·08.	Cholera in Ajmere district and Merwara has not yet disappeared. Cattle-disease reported in some parts of Merwara. Prices stationary.
Jeypore („ „)	. . . . . .	Prospects depend on break in rains. Ten cases of cholera in Jeypore city.
Kerowlee („ 3rd)	1·67	Tanks and wells full. Crops damaged. Cholera continues. Prices rising.
Dholepore („ „)	Average 5·20	Tanks and wells full. Crops injured by excessive rains. Cholera still lingering at Bari. Prices rising. Weather seasonable.
Bhurtpore („ 6th)	Continuous rain 4·70	Crops suffering. Break needed.
Ulwar („ „)	. . . . . .	No report received.
Kotah („ 3rd)	3·20	Health good. *Makki* crops injured by continuous rain. Weather overcast.
Kherwara („ 4th)	·15	Rain needed to fill tanks and wells. Crops fair. Bowel-complaints prevail. Cattle mortality from disease spreading. Prices unchanged. Weather fine.
Bickanir („ 3rd)	·40; Rainfall heavier in some districts.	Tanks and wells full. Prospects good. Health good. Prices stationary. Weather cloudy.
Nepal—(Sept. 2nd)		
Katmandu (Sept. 1st)	4·38	Weather seasonable. Prospects fair.

E. C. BUCK,

Secretary to the Government of India.

GOVERNMENT OF INDIA.

REVENUE AND AGRICULTURAL DEPARTMENT.

Weather Review of India for the week ending the 7th September, 1887.

During the week under review there has occurred a steady change in the weather over a large part of India, from general rain towards finer conditions. This change has been most marked in Northern India, where at the close of the week a general break in the rains obtained.

On the 1st a moderate monsoon was blowing along the West Coast and a strong monsoon on the Sind and Cutch Coasts. Most of the rainfall connected with this current fell at the more southern of the Indian Stations and in Ceylon. Rajkot received 2 inches, but in Bombay and the Central Provinces the rainfall was only moderate. There was no change in the winds in the West on the 2nd, but the rainfall was generally rather slighter though fairly general over the West Coast districts and the Central Provinces. On the 3rd there occurred a large increase in the force of the wind along the West Coast (from Ceylon as far North as Surat), and the strong monsoon current penetrated far into the Central parts of the country. As a consequence, moderate rain fell over the whole of the West Coast districts, the Central Provinces, and nearly the whole of the Deccan and Madras, while showers fell in Rajputana and Central India. This strong monsoon continued during the 4th, but the rainfall, though heavier in the West and Centre than on the 3rd, was more restricted as to extent, and Sind, Guzerat, Rajputana, Central India, and Southern India were practically rainless. On the 5th the force of the wind fell again, and, except in Ceylon, the monsoon was below its average strength. This change was accompanied by a decrease in the amount and extent of the rainfall. On the 6th a further decrease in the strength of the monsoon occurred, and the rainfall was everywhere small in amount and confined chiefly to the West Coast and Southern India. Only local showers fell in the Central Provinces and Central India, and no rain in Sind or Rajputana. On the 7th very feeble winds prevailed on the West Coast and light variable airs at the inland stations. Southern India was the only region receiving general rain, the falls elsewhere being confined to light showers of no importance.

The monsoon of the Bay of Bengal has undergone a change similar to that experienced by the West Coast current. On the 1st there was a moderate monsoon blowing from the Bay into Bengal, and moderate but general rain fell in Bengal and Burma. On the 2nd the monsoon continued up to the average, and somewhat heavier rain fell over the districts fed by this current. On the 3rd the winds at the head of the Bay strengthened considerably, and this increase was felt inland as far as Behar. Accompanying this increase in the wind came heavier and more general rain. Assam, Bengal, Behar, Chutia Nagpur and the North-Western Provinces, all had moderate rain, and these favourable conditions lasted over the following day. On the 5th, however, a change set in. The force of the wind decreased and the rain, though fairly general, was much lighter than on the preceding day. On the 6th and 7th the winds were very light, and a general break in the rains prevailed.

In Upper India conditions have been more or less similar. Heavy local showers fell in the Punjab and western districts of the North Western Provinces on the 1st. These were continued during the 2nd, 3rd, and 4th, but on the 5th the weather began to change, the sky cleared considerably, and during the 6th and 7th fine bright weather prevailed, and a well-marked break in the rains obtained throughout Northern, Western, and Central India.

As is almost invariably the case when a break occurs in the rains over Northern India, the rainfall over the Peninsula has been above the average.

The following table shows the state of the seasonal rainfall:

Stations.		Total Rainfall since June 1st, 1887.	Average Rainfall, June 1st to September 7th.	Difference.
Akyab	...	112·90	139·28	—26·38
Saugor Island	...	41·25	46·88	— 5·63
Calcutta	...	35·33	41·46	— 6·13
Dhubri	...	50·94	54·95	— 4·01
Purneah	...	40·29	45·13	— 4·84
Gya	...	28·34	31·43	— 3·09
Allahabad	...	32·30	28·35	+ 3·95
Meerut	...	21·08	20·14	+ 0·94
Delhi	...	33·61	18·76	+14·85
Lahore	...	16·07	11·85	+ 4·22
Peshawar	...	1·96	5·09	— 3·13
Cochin	...	59·57	74·97	—15·40
Ratnagiri	...	90·96	88·73	+ 2·23
Bombay	...	73·92	59·83	+14·09
Poona	...	17·95	18·31	— 0·36
Surat	...	36·09	33·40	+ 2·69
Khandwa	...	27·75	25·73	+ 2·02
Nagpur	...	43·68	32·45	+11·23

Except in the North-Western Provinces, the Punjab, the Konkan, and the Central parts of the country, the rainfall is generally deficient, but, on the whole, the differences, as compared with the totals, are small enough to be without importance.

Pressure has been generally above the average over Upper and Central India and below it over the Peninsula. The distribution during the latter part of the week was very irregular and more like that of October than that of the early part of September.

On the mean of the whole week temperature was below the normal, but during the past few days there has occurred a brisk rise of the thermometer, which, if the present break in the rains continues, will soon bring the temperature above the normal.

The concluding table gives the total rainfall of the past week for the different Provinces:

Divisions.		No. of Stations.	Total Rainfall.
Burmah	...	6	15·07
Bengal and Assam	...	16	43·76
North-Western Provinces and Oudh	...	9	18·69
Punjab	...	7	14·64
Hill Stations	...	5	10·05
Ceylon	...	2	5·62
Malabar Coast	...	5	27·75
Bombay	...	9	14·93
Berars and Central Provinces	...	10	23·41
Guzerat and Central India	...	4	6·09
Sind—Rajputana	...	3	3·13
Madras	...	14	38·19

W. L. DALLAS,
for *Meteorological Reporter to the Government of India.*

SIMLA, *9th September, 1887.*

E. C. BUCK,
Secretary to the Government of India.

GOVERNMENT OF INDIA.

PUBLIC WORKS DEPARTMENT.

RAILWAY TRAFFIC.

No. XVIII OF 1887-88.

APPROXIMATE STATEMENT OF GROSS RECEIPTS AND EXPENSES OF INDIAN RAILWAYS.

N.B.—As regards the figures in column *Total Receipts from 1st April to date*, audited figures have been used, as far as possible.

Latest Return received.	RAILWAYS.	Total mean length open.	RECEIPTS FOR WEEK ENDING 7TH AUGUST, 1886.		Total mean length open.	RECEIPTS FOR WEEK ENDING 6TH AUGUST, 1887.		TOTAL RECEIPTS FROM 1ST APRIL TO 7TH AUGUST, 1886.		TOTAL RECEIPTS FROM 1ST APRIL TO 6TH AUGUST, 1887.		Total increase in 1887-88.	Total decrease in 1887-88.
			Total.	Per mile open.		Total.	Per mile open.	Total.	Per mile open per week.	Total.	Per mile open per week.		
	Lines worked by Guaranteed Companies.		*Rs.*	*Rs.*		*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*
20th August, 1887	Oudh and Rohilkhand	680	80,401	118	686	88,956	130	25,25,669	201	23,59,369	188	...	1,66,300
13th ditto	Madras	801	1,45,086	169	831	1,49,280	180	28,22,076	178	29,60,280	195	1,38,204	...
13th ditto	South Indian	654	92,049	141	654	86,544	132	18,70,624	155	18,51,290	155	...	19,334
20th ditto	Great Indian Peninsula	1,497	5,51,806	309	1,496	4,28,241	286	1,50,89,909	547	1,60,74,047	587	9,84,138	...
20th ditto	Bombay, Baroda and Central India	461	1,79,948	390	461	1,24,000	269	54,15,526	637	49,09,367	582	...	5,06,159
	TOTAL	4,153	10,49,950	253	4,128	8,77,021	212	2,77,23,804	362	2,81,54,353	373	4,30,549	...
	State Lines worked by Guaranteed Companies.												
20th August, 1887	East Indian	1,515	6,89,363	455	1,519	6,32,763	417	1,68,22,412	602	1,63,29,753	588	...	4,92,659
20th ditto	Patna-Gya	57	8,030	141	57	6,883	121	1,71,778	164	1,60,690	154	...	11,088
20th ditto	Dildarnagar-Ghazipur	12	605	50	12	701	58	21,219	96	18,704	85	...	2,515
27th ditto	Sindia	75	5,902	79	75	5,843	78	1,30,405	94	1,48,287	108	17,882	...
20th ditto	Rajputana-Malwa (*a*)	1,664	3,10,508	190	1,664	1,92,000	115	67,91,457	221	58,96,150	194	...	8,95,307
20th ditto	Bengal-Nagpur (late Nagpur-Chhattisgarh)	149	11,149	75	149	11,349	76	5,61,169	204	5,38,899	198	...	22,270
20th ditto	Southern Mahratta (*b*)	315	30,433	97	764	52,896	69	6,33,632	109	11,15,821	92	4,82,189	...
27th ditto	Indian Midland	42	1,320	31	42	1,022	24	33,757	44	59,141	77	25,384	...
13th ditto	Lucknow-Sitapur-Sihramau	...	...	...	85	2,963	35	...	...	72,059	48	72,059	...
	TOTAL	3,829	10,63,370	278	4,367	9,06,414	208	2,51,65,829	357	2,43,39,504	312	...	8,26,325
	State Lines worked by Government.												
13th August, 1887	Eastern Bengal (*c*)	606	1,17,688	194	645	1,52,550	237	24,74,928	222	25,64,548	217	89,620	...
20th ditto	Nalhati	27	992	37	27	2,332	86	31,782	64	35,094	71	3,312	...
20th ditto	Tirhoot	240	23,109	94	249	23,896	96	5,96,357	131	6,23,080	137	26,729	...
20th ditto	Wardha Coal	45	9,430	210	45	13,203	293	2,48,075	299	2,69,085	347	21,010	...
13th ditto	Burma	327	34,332	99	327	48,299	148	7,85,372	130	10,50,169	170	2,64,797	...
13th ditto	Cherra-Companyganj	7	74	10	7	26	4	(*d*) 223	6	734	6	511	...
20th ditto	North-Western (*e*)	1,885	4,46,640	237	2,094	3,42,164	164	93,49,591	269	76,46,525	200	...	17,03,066
20th ditto	Bareilly-Pilibheet	36	624	17	36	1,151	32	36,581	55	32,741	50	...	3,840
13th ditto	Jorhat	26	709	27	26	790	30	12,005	20	17,757	38	5,152	...
20th ditto	Bilaspur-Etawa (Katni-Umaria Section)	...	...	...	37	802	22	...	...	24,962	37	24,962	...
	TOTAL	3,205	6,31,804	197	3,493	5,85,213	168	1,35,35,514	229	1,22,64,701	192	...	12,70,813
GRAND TOTAL (GUARANTEED AND STATE)		11,187	27,45,124	245	11,988	23,68,648	198	6,64,25,147	322	6,47,58,558	298	...	16,66,589
	GROSS ESTIMATED EXPENSES	...	...	...	...	...	...	3,17,86,719	154	(*f*)3,07,89,026	142	...	...
	NET RECEIPTS	...	...	...	...	...	...	3,46,38,428	168	3,39,69,532	156	...	6,68,896
	Assisted Companies.												
20th August, 1887	Bengal Central	125	7,858	63	125	9,460	76	2,23,624	97	2,24,110	98	486	...
20th ditto	Rohilkhand-Kumaon	67	4,696	70	67	4,614	69	1,25,842	102	1,24,289	101	...	1,553
13th ditto	Dibru-Sadiya (late Assam)	78	5,542	71	78	8,505	109	1,19,681	83	1,55,378	109	35,697	...
20th ditto	Bengal and North-Western	303	25,555	84	376	25,400	68	7,82,093	140	8,32,087	121	49,994	...
20th ditto	Tarakessur	22	3,491	159	22	4,110	187	96,099	237	1,00,918	251	4,819	...
	TOTAL	595	47,142	79	668	52,089	78	13,47,339	123	14,36,782	118	89,443	...
	Native States.												
20th August, 1887	Bhavnagar Gondal	193	12,323	64	193	10,447	54	4,13,281	116	4,18,216	118	4,935	...
13th ditto	Jodhpore	64	3,204	50	124	5,400	44	70,678	60	1,28,809	57	58,131	...
20th ditto	Nizam's	208	26,838	129	208	28,414	137	4,72,245	123	5,66,096	149	93,851	...
13th ditto	Mysore	140	7,755	55	140	9,042	69	1,57,277	61	1,76,792	69	19,515	...
20th ditto	Morvi	24	279	12	68	1,898	28	18,552	42	60,432	48	41,880	...
20th ditto	H. H. the Gaekwar's Mehsana-Vadnagar	...	...	...	21	400	19	...	...	14,771	38	14,771	...
	TOTAL	629	50,399	80	754	56,201	75	11,32,033	98	13,65,116	99	2,33,083	...

(*a*) Includes the Cawnpore-Achnera State Railway.
(*b*) Includes the Bellary-Kistna State Railway.
(*c*) Includes the Northern Bengal, Dacca, Kaunia-Dharlla, and Assam-Behar State Railways.
(*d*) Total Receipts from 1st July to 7th August, 1886.
(*e*) Includes the Amritsar-Pathankot and Rajpura-Patiala State Railways.
(*f*) Calculated on percentage used for the corresponding period of 1886.

SIMLA;
The 8th September, 1887.

JAMES RAMSAY,
Offg. Under-Secretary.

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SUPPLEMENT TO

The Gazette of India.

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OFFICIAL PAPERS.

A SUPPLEMENT *to the* GAZETTE OF INDIA *will be published from time to time, containing such Official Papers and information as the Government of India may deem to be of interest to the Public, and such as may usefully be made known. The Debates of the Legislative Council of His Excellency the Governor General will in future be published in* PART VI *of the* GAZETTE.

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GOVERNMENT OF INDIA.

PUBLIC WORKS DEPARTMENT.

Civil Works—Irrigation.

COMPARATIVE STATEMENT OF IRRIGATION AND RAINFALL ON INUNDATION CANALS IN THE PUNJAB FOR THE YEARS 1885-86 AND 1886-87.

IRRIGATION OPERATIONS, 1886-87.

Comparative Statement of Irrigation and Rainfall for the years 1885-86 and 1886-87 in the Districts of the Punjab irrigated by Inundation Canals.

Districts.	Population.	Area in acres.	Cultivated area in acres.	AREA IRRIGATED.										RAINFALL.		
				Kharif, 1886-87.			Rabi, 1886-87.			Whole year, 1886-87.			Percentage of increase or decrease in 1886-87.	1885-86.	1886-87.	Percentage of increase or decrease in 1886-87.
				Total in acres.	In comparison with 1885-86.		Total in acres.	In comparison with 1885-86.		Total in acres.	In comparison with 1885-86.					
					Increase.	Decrease.		Increase.	Decrease.		Increase.	Decrease.				
Lahore	924,106	2,334,552	1,164,921	17,396	2,670	...	9,730	...	571	27,126	2,099	...	+ 8·38	9·6	18·8	95·8
Montgomery	426,529	3,567,750	357,622	55,721	21,931	...	20,325	3,154	...	76,046	25,085	...	+49·22	5·0	10·13	102·6
Montgomery (Lower Sohág and Pára Canal)	...	...	...	9,229	1,678	...	8,253	...	1,442	17,482	236	...	+ 1·37	...	...	...
Mooltan	551,964	3,763,200	799,360	182,323	1,380	...	142,289	...	5,530	324,612	...	4,150	− 1·25	9·7	3·5	−63·9
Mooltan (Sidhnai Canal)	...	...	...	7,188	7,188	...	20,603	20,603	...	27,791	27,791	...	...	...	...	...
Muzaffargarh	338,605	2,007,819	397,529	125,943	...	2,834	149,469	25,986	...	275,412	23,152	...	+ 9·17	9·1	2·8	−69·2
Dera Ghazi Khan	363,346	2,801,280	1,008,000	131,487	4,176	...	47,184	2,373	...	178,671	6,549	...	+ 3 8	8·55	3·2	−62·5
Shahpur	421,508	3,031,700	585,491	8,174	...	762	5,193	...	1,600	13,367	...	2,362	−15·0	15·4	14·5	− 5·8
TOTAL INUNDATION CANALS	3,026,058	17,506,301	4,312,923	537,461	39,023	3,596	403,046	52,116	9,143	940,507	84,912	6,512	+ 9·1	...	...	...

Area irrigated in 1886-87	940,507	Acres.
Ditto 1885-86	862,107	"
NET INCREASE	78,400	"

SIDNEY PRESTON,

Under-Secy. to Govt., Punjab, P. W. D., Irrigation Branch.

GOVERNMENT OF INDIA.

DEPARTMENT OF FINANCE AND COMMERCE.

SUPPLEMENT TO THE STATEMENTS OF PRICES CURRENT (RETAIL) OF FOOD-GRAINS FOR THE 2nd HALF OF JUNE 1887 PUBLISHED IN PAGES 971, 975 OF THE SUPPLEMENT TO THE "GAZETTE OF INDIA," DATED 23rd JULY 1887.

PROVINCE.	DISTRICTS.	AVERAGE WAGES PER MONTH.		
		Able-bodied Agricultural labourer.	Syce or Horse-keeper.	Common Mason, Carpenter, or Blacksmith.
		R a. p.	*R a. p.*	*R a. p.*
BOMBAY	Shikarpur	8 0 0	8 0 0	30 0 0
	Sukkur	8 0 0	9 0 0	30 0 0
RAJPOOTANA	Deoli Cantonment	2-0 to 3-0	...	4-0 to 5-0

E. T. ATKINSON,

Offg. Secretary to the Government of India.

DEPARTMENT OF FINANCE AND COMMERCE,
(*Statistical Branch*).

GOVERNMENT OF INDIA.

PUBLIC WORKS DEPARTMENT.

Civil Works—Irrigation.

USE OF WATER-POWER FOR WORKING MACHINERY ON THE SIRHIND CANAL.

Proceedings of the Hon'ble the Lieutenant-Governor of the Punjab in the Public Works Department, Irrigation Branch,—No. 3539 I., dated the 28th July 1887.

READ—

Punjab Government Resolution No. 3765, dated 5th October 1881.

OBSERVATIONS.—In accordance with the abovementioned Resolution, lists of sites at which water-power was available on the Bári Doáb and Western Jumna Canals were published for general information.

2. The Sirhind Canal having now been opened for irrigation and navigation, the Lieutenant-Governor considers that the vast power which is available thereon should be brought before public notice in a similar manner.

3. The annexed map shows the position of the falls, roads, rail-roads, railway stations and principal towns.

The portions of the canal which are navigable have been distinguished from those which are not, and the horse-power available at each site is also shown.

4. The total power available on the Sirhind Canal will be about 9,914 horse-power distributed over 44 sites, *viz.*—

Abohar Branch	4,334 H.-P. at	14 sites.
Bhatinda Branch	3,589 „ „	14 „
Kotla Branch	1,648 „ „	9 „
Gaggar Branch	233 „ „	4 „
Choa Branch	110 „ „	3 „
TOTAL	9,914 H.-P. at	44 sites.

5. The standard assumed for calculation of one horse-power is the same as for the Bári Doáb and Western Jumna Canals, *viz.*, 15 cubic feet per second falling one foot, and in making the calculation for each site 50 H. P. have been deducted from the result to allow for existing flour mills or for those that may be erected in future.

6. The Sirhind Canal lies partly in British territory and partly in the Native States of Patiála, Nábha, Jínd, Maler Kotla and Farídkot. The principal British districts traversed are Ludhiána and Ferozepore with populations of 450 and 236 per square mile respectively.

The principal crops grown in these districts are—

Name of Crop.	Districts.	
	Ludhiána.	Ferozepore.
	Acres.	Acres.
Rice	2,683	2,921
Wheat	177,644	395,850
Other food-grains	154,336	450,057
Pulses	184,289	563,463
Drugs and spices	1,725	3,108
Oil-seeds	5,515	52,970
Fibres	19,261	14,326
Sugarcane	14,209	2,712

and the rates for labour are—

Skilled	6 to 8 annas per diem.
Unskilled	2½ to 4 annas per diem.

7. The Government is prepared to grant the use of the water for working machinery for periods not exceeding 20 years on the terms shown below :—

Approximate rates per H.-P. per annum.

	Years.	R
For first term	3	*Nil.*
„ second term	5	60
„ third „	6	100
„ fourth „	6	150

The exact terms will be the subject of special agreement in each case, and special rates will be levied on water used for the purpose of grinding grains, based upon the rates paid by Native millers at various sites on the canal.

8. Particulars regarding the conditions on which mill heads and tails may be built and the water-power used, and any further information required, will be supplied to applicants by the Superintending Engineer, Sirhind Canal Circle, Umballa.

RESOLVED—that the above observations, with the list of water-power available, be published in the Supplement to the *Punjab Gazette* for general information.

Also that 20 copies with explanatory maps be forwarded to the Government of India for information and distribution.

By order of the Hon'ble the Lieutenant-Governor,

F. J. HOME, *Lieut.-Col., R.E.*,

Offg. Joint Secretary to Government, Punjab, P. W. D., Irrigation Branch.

SIRHIND CANAL.

List showing localities at which water-power is available.

Name of Canal.		Name and Number of Fall.	Mileage from Head of Branch.		Miles from and Name of nearest Civil Station or large Native Mart in the District.		Miles from nearest Railway Station.		Total effective horse power available at site.	Height Fall.	Remarks.
			Miles.	Feet.		Miles.		Miles,	H. P.		
SIRHIND CANAL.	ABOHAR BRANCH.	1. Bowani	0	0000	Ludhiana	14	Doraha	4	155	3·0′	
		2. Khanpur	4	3,000	Do.	11	Sanchwal	6	498	8·0′	
		3. Chupki	9	2,000	Do.	11	Ludhiana	11	462	8.0′	
		4. Ballowal	13	4,500	Do.	13	Do.	13	451	8·0′	
		5. Akalgurh	21	000	Jagraon	12	Do.	18	440	8·0′	
		6. Tugal	25	3,000	Do.	8	Do.	21	428	8·0′	
		7. Akhara	31	2,000	Do.	3	Do.	27	291	6·0′	
		8. Dalla	36	000	Do.	7	Do.	32	394	8·0′	
		9. Daodhar	42	3,000	Do.	14	Do.	36	458	10·0′	
		10. Gholia	50	4,000	Mogah Ferozepore	14 45	KotKapura	26	265	8·0′	
		11 Chunowal	57	4.000	Mogah Ferezepore	14 40	Do.	19	178	8·0′	
		12. Samalsar	66	4,000	Faridkot	13	Do.	11	160	8·0′	
		13. Sibian	72	000	Kot Kapura Faridkot	5 13	Do.	5	112	6·5′	
		14. Nawa Hari	80	4,000	Kot Kapura Faridkot	7 15	Do.	7	42	4·0′	
							TOTAL		4,334		
	BHATTINDA BRANCH.	1. Bowani	0	0000	Ludhiana	14	Doraha	4	75	2·0′	
		2. Khatra	6	2,250	Do.	17	Do.	10	440	8·0′	
		3. Janghera	11	3,900	Kotla	13	Ludhiana Doraha	17 16	405	8·0′	
		4. Kanganwala	17	2,500	Do.	10	Ludhiana	22	505	10·0′	
		5. Mahohi	21	4,000	Raekot	9	Do.	27	258	6·0′	
		6. Lohgarh	25	3,000	Do.	5	Do.	33	360	8·0′	
		7. Dadahur	31	500	Do.	5	Do.	33	240	6·0′	
		8. Chakh Shai	37	000	Do.	9	Do.	37	381	9·5′	
		9. Tillewal	44	1,750	Senah Rackot	6 17	Bhattinda Ludhiana	40 44	204	6·0′	
		10. Balloka	55	2,000	Senah	7	Bhattinda	30	265	8·0′	
		11. HarnamSingh	61	2,000	Nathana Bhattinda	9 23	Do.	24	226	8·0′	
		12. Pohla	70	500	Nathana Bhattinda	2 14	Do.	15	100	5·0′	
		13. Bibiwala	78	0	Bhatinda	6	Do.	7	92	5·0′	
		14. Bhattinda	82	1,300	Do.	2	Do.	2	38	6·0′	
							TOTAL		3,589		
	KOTLA BRANCH.	1. Doolawal	3	0	Maler Kotla	10	Khunna	17	265	8·0′	
		2. Salar	7	700	Do.	6	Do.	21½	253	8·0′	
		3. Banboorah	12	1,500	Do.	6	Do.	27	241	8·0′	
		4. Babanpur	17	1,200	Do.	7	Ludhiana	35	158	6·0′	
		5. Boogra	24	2,000	Sangrur	9	Do.	41	213	8·0′	
		6. Raipur	29	1,000	Do.	9	Do.	46	138	6·0′	
		7. Harrigarh	37	0	Do.	18	Sheergarh	49	177	8·0′	
		8. Sookee	43	0	Bhattinda	40	Do.	43	148	8·0′	
		9. Rulla	53	4,000	Do.	32	Do.	32	55	8·0′	
							TOTAL		1,648		
	GUGGAR BRANCH.	1. Thui	4	3,000	Nabah	4½	Patiala	17	129	10·0′	
		2. Nidampur	11	0	Do.	11	Do.	17	64	8·0′	
		3. Gujran	23	3,000	Sangrur	12	Do.	30	29	7·0′	
		4. Salar	27	0	Sonam	10	Do.	34½	11	8·0′	
							TOTAL		233		
	CHOA RANCH.	1. Pussiana	3	3,000	Patiala	4	Partiala	4	50	10·0′	
		2. Dekraba	8	3,507	Do.	9	Do.	9	40	10·0′	
		3. Lalgurh	15	500	Samaha	3	Do.	16	20	10·0,	
							TOTAL		110		

GOVERNMENT OF INDIA.

PUBLIC WORKS DEPARTMENT.

Civil Works—Irrigation.

STATEMENTS OF IRRIGATION OPERATIONS ON THE INUNDATION CANALS IN THE PUNJAB FOR THE RABI CROP OF 1886-87.

STATEMENT No. I.

IRRIGATION OPERATIONS OF THE RABI CROP OF 1886-87 ON INUNDATION CANALS.

Comparative Abstract of Irrigation and Rainfall in Canal Districts of the Punjab.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
District.	Area in acres.	Cultivated area in acres.	Area Irrigated.		Comparison with last Crop.		Rainfall in Rabi Months.													
							October.		November.		December.		January.		February.		March.		Total.	
			1886-87.	1885-86.	Increase.	Decrease.	1886.	1885.	1886.	1885.	1886.	1885.	1887.	1886.	1887.	1886.	1887.	1886.	1886-87.	1885-86.
Lahore	2,334,552	1,164,921	9,730	10,301	...	571	...	...	...	...	0·2	2·1	0·4	0·80	0·7	0·47	...	1·2	1·3	4·6
Montgomery	3,567,750	357,622	20,325	17,171	3,154	...	0·9	...	0·1	...	...	0·9	0·2	0·5	0·5	...	...	0·5	1·7	1·9
Montgomery (Lower Sohág and Pára Canal	...	...	8,253	9,695	...	1,442	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Mooltan	3,763,200	799,360	142,289	147,819	...	5,530	...	...	0·5	...	...	0·2	...	1·5	...	...	...	1·5	0·5	3·2
Mooltan (Sidhnai Canal)	...	...	20,603	...	20,603	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Muzaffargarh	2,007,819	397,529	149,469	123,483	25,986	...	...	...	0·7	...	...	...	...	1·2	...	...	...	0·9	0·7	2·1
Dera Gházi Khan	2,801,280	1,008,000	47,184	44,811	2,373	...	...	...	10·4	...	...	...	0·2	2·10	...	...	...	1·4	0·6	3·5
Shahpur	3,031,700	585,491	5,193	6,798	...	1,600	...	...	...	...	...	...	...	1·2	...	0·5	2·9	3·3	2·9	5·0
Total Inundation Canals	17,506,301	4,312,923	403,046	360,073	52,116	9,143	...	...	...	...	...	...	...	...	...	...	...	...	...	...

(1) The increase on Upper Sutlej Canals in Lahore District is due to the better supply of water in canals, and decrease on Lower Soháq Canal is partly due to the early failure of water in the river and to there being no suitable water-courses for existing villages along the new part opened up during the year. In previous rabi the whole supply was ponded up at Haveli, and the country round was flooded; but this wasteful system was exceptional, and cannot be repeated now that the canal below Haveli has been opened.

	Acres.
Area irrigated in 1886-87	403,046
Ditto 1885-86	360,073
Net increase	42,973

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STATEMENT No. II.

IRRIGATION OPERATIONS OF THE RABI CROP OF 1886-87 ON INUNDATION CANALS.

Statement in Acres of Crops irrigated in Canal Districts.

Description of Crops.	Lahore.	Montgomery.	Montgomery (Lower Sohág and Pára Canal).	Mooltan.	Mooltan (Sidhnai Canal).	Muzaffargarh.	Dera Gházi Khan.	Shapur.	Total.
Wheat	3,521	11,113	6,774	98,591	14,954	102,848	41,123	1,469	280,393
barley	92	331	267	1,743	457	4,219	25	...	7,134
Mixed Grain	2,622	1,629	369	...	...	5,075	1,888	158	11,741
Others	3,495	7,252	843	41,955	5,192	37,327	4,148	3,566	103,778
Total Rabi, 1886-87	9,730	20,325	8,253	142,289	20,603	149,469	47,184	5,193	403,046
Total Rabi, 1885-86	10,301	26,866		147,819		123,483	44,811	6,793	360,073

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STATEMENT No. III.

IRRIGATION OPERATIONS OF THE RABI CROP OF 1886-87 ON INUNDATION CANALS.

Statement in Acres of Crops irrigated in Canal Divisions.

Description of Crops.	Upper Sutlej Canals.	Lower Sohág and Pára Canal	Lower Sutlej and Chenab Canals.	Sidhnai Canal.	Mozaffargarh Canals.	Indus Canals.	Shahpur Canals.	Total.
Wheat	14,634	6,774	98,591	14,954	102,848	41,123	1,469	280,393
Barley	423	267	1,743	457	4,219	25	...	7,134
Mixed grain	4,251	369	...	...	5,075	1,888	158	11,741
Others	10,747	843	41,955	5,192	37,327	4,148	3,566	103,778
Total Rabi, 1886-87	30,055	8,253	142,289	20,603	149,469	47,184	5,193	403,046
Total Rabi, 1885-86	27,472	9,695	147,819		123,483	44,811	6,793	360,073

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